A1960-5U '89

AMERICAN INSTITUTE OF PHYSICS

AIP REPORT

335 East 45th Street
New York, NY 10017-3483

EDUCATION & EMPLOYMENT
STATISTICS DIVISION

Tel. 212-661-9404

SOCIETY MEMBERSHIP PROFILE: EMPLOYMENT MOBILITY AND CAREER CHANGE

Beverly Fearn Porter and Dawn Kellman

The American Physical Society
Optical Society of America
Acoustical Society of America
The Society of Rheology
American Association of Physics Teachers
American Crystallographic Association
American Astronomical Society
American Association of Physicists in Medicine
American Vacuum Society
American Geophysical Union

THE AMERICAN INSTITUTE OF PHYSICS

The American Institute of Physics is a not-for-profit membership corporation chartered in New York State in 1931 for the purpose of promoting the advancement and diffusion of knowledge in physics and its application to human welfare.

It is the mission of the Institute to serve the sciences of physics and astronomy by serving the Societies, by serving individual scientists, and by serving students and the general public. The Institute

* publishes its own scientific journals as well as those of its Member Societies;
* publishes both technical and general-interest books;
* provides abstracting and indexing services;
* serves the public by making available to the press and other channels of public information reliable communications on physics and astronomy;
* collects and analyzes statistics on the profession and on physics education;
* encourages and assists in the documentation and study of the history and philosophy of physics;
* cooperates with local, national, and international organizations devoted to physics and related sciences; and
* collects and distributes information on Federal programs and budgets.

The scientists represented by the Institute through its Member Societies number approximately 89,000. In addition, approximately 7,600 students in over 545 colleges and universities are members of the Institute's Society of Physics Students, which includes the honor society, Sigma Pi Sigma. Industry is represented through some 100 Corporate Associates members. AIP's monthly magazine, PHYSICS TODAY, reaches all these people and organizations.

The Education and Employment Statistics Division provides reliable information on the composition and dynamics of the scientific labor force and education system to the physics community for use in self-assessment. Its program involves regular data collection and analysis, information dissemination, and report publication.

MEMBER SOCIETIES

The American Physical Society
Optical Society of America
Acoustical Society of America
The Society of Rheology
American Association of Physics Teachers
American Crystallographic Association
American Astronomical Society
American Association of Physicists in Medicine
American Vacuum Society
American Geophysical Union

AIP OFFICERS

Hans Frauenfelder, Chair, Governing Board
Kenneth W. Ford, Executive Director and CEO
Roderick M. Grant, Secretary
Gerald F. Gilbert, Treasurer
Robert E. Baensch, Director of Publishing
John S. Rigden, Director of Physics Programs

EDUCATION AND EMPLOYMENT STATISTICS DIVISION

Beverly Fearn Porter, Manager

OTHER STATISTICS DIVISION PUBLICATIONS

Annual Reports
- Graduate Student Survey
- Employment Survey
- Enrollments and Degrees
- Survey of Physics and Astronomy Bachelor's Degree Recipients
- Society Membership Salary Survey
- Society Membership Profile

Special Focus Reports
- Survey of Foreign Teaching Assistants in Physics
- Physics in the High School
- Who Takes Science?

SOCIETY MEMBERSHIP PROFILE: EMPLOYMENT MOBILITY AND CAREER CHANGE

Beverly Fearn Porter and Dawn Kellman

The American Physical Society
Optical Society of America
Acoustical Society of America
The Society of Rheology
American Association of Physics Teachers
American Crystallographic Association
American Astronomical Society
American Association of Physicists in Medicine
American Vacuum Society
American Geophysical Union

Copyright © 1989 American Institute of Physics

All rights reserved. No part of this publication may be reproduced without prior written permission of the publisher.

International Standard Book Number: 0-88318-620-9
AIP Publication Number: R-306.2 June 1989

Distributed by
Education and Employment Statistics Division
American Institute of Physics
335 East 45th Street
New York, New York 10017
(212) 661-9404

Printed in the United States of America

Price: single copies free; multiple copies on request

TABLE OF CONTENTS

	Page
INTRODUCTION	1
MEMBERSHIP COMPOSITION	1
Demographics	1
Professional Self-Identification	2
Location	2
EMPLOYMENT	2
University	3
Other Academic Settings	4
Industry	4
National Laboratories	5
Government	5
SALARIES	5
Salaries and Degree Level	5
Salaries and Employment Sector	6
Salaries and Geographic Location for PhDs	6
Salaries and Primary Work Activity	7
EMPLOYMENT MOBILITY AND CAREER CHANGE	7
Introduction	7
Early Career Change	8
Mid-Career Changes	11
Retirement and Late Career Mobility	15
Concluding Remarks	17
SOCIETY MEMBERSHIP COMPARISONS AND PROFILES	18
APPENDICES	
A. Dropping Society Membership	22
B. Geographic Divisions	23
C. Detailed Statistical Tables	24
D. Methodology	37
E. Definitions and Technical Notes	37
F. Questionnaire Instruments and Subfield List	39

TABLES AND FIGURES APPEARING IN THE TEXT

		Page
TABLE I.	Society members residing in selected foreign countries, 1986.	3
TABLE II.	Employer mobility between 1981 and 1985 of recent PhDs.	9
TABLE III.	1985 basic research involvement by 1981 postdoctoral status, recent PhDs.	10
TABLE IV.	Primary work activity of recent PhDs employed in industry, 1981.	11
TABLE V.	Type of employer for PhDs in the experienced labor force, 1981.	12
TABLE VI.	Type of employer movement between 1981 and 1985 for mobile PhDs in the experienced labor force.	13
TABLE VII.	Academic rank mobility between 1981 and 1985.	13
TABLE VIII.	Work activities of PhDs remaining with the same industrial employer between 1981 and 1985.	14
TABLE IX.	Work activities of PhDs changing industrial employer between 1981 and 1985.	14
TABLE X.	Work activity of PhDs leaving the national laboratories between 1981 and 1985.	15
TABLE XI.	The retirement process in the 1980's.	16
TABLE XII.	Full- to part-time employment change for individuals aged 55 and older.	16
TABLE XIII.	Full-time employment changes for individuals aged 60 and older.	17
TABLE XIV.	International distribution of membership for each society, 1986.	19
TABLE XV.	U.S. membership concentration within major states for each society, 1986.	19
TABLE XVI.	Society cross membership, 1986.	20

FIGURE 1.	Age profile of society members, 1986.	1
FIGURE 2.	Professional self-identification, 1986.	2
FIGURE 3.	Regional distribution of society members, 1986.	3
FIGURE 4.	Type of employer, 1986.	3
FIGURE 5.	Current employer type by year of PhD, 1986.	4
FIGURE 6.	Work activity by selected type of employer, 1986.	4
FIGURE 7.	Median salaries for PhDs, 1979–1986.	5
FIGURE 8.	University and 4-year college salaries for PhDs by academic rank, 1986.	6
FIGURE 9.	Median salaries for PhDs in each of 12 metropolitan areas, 1986.	7
FIGURE 10.	Level of employer mobility between 1981 and 1985 for different age groups.	8
FIGURE 11.	Initial employment of recent PhDs, 1981.	9
FIGURE 12.	Continuation in dissertation subfield through 1985, recent PhDs.	11
FIGURE 13.	Employer mobility between 1981 and 1985 for PhDs in the experienced labor force.	12
FIGURE 14.	Mobility between 1981 and 1985 of experienced PhDs in government by their initial work activity in 1981.	14
FIGURE 15.	Retirement in the 1980's by age and employment sector.	16
FIGURE 16.	Professional self-identifieation for each society, 1986.	18
FIGURE 17.	Broad employer types for each society, 1986.	21

INTRODUCTION

The past several decades have brought a dramatic roller coaster of changes to the physics community. In the 1960's, rising college enrollments and the Sputnik-induced interest in science set off an explosion of physics opportunities in academe. Barely a decade later this apparently unbounded growth was followed by painful shrinkages in the scientific labor market. Research funding dried up and physics enrollments plummeted. By the 1980's a slow but cautious resurgence, fueled by an increase in industrial demand and a growth in interdisciplinary specialties, was underway. As we enter the 1990's and approach the start of a new century, no one can predict with certainty what new events will emerge, yet many indicators point to rising demand in both the academic and non-academic spheres.

Fluctuations in demand have, thus, become halimarks of the scientific enterprise. Career change and employment mobility are important mechanisms by which the profession responds to these fluctuations. Sometimes this entails major movements from one discipline to another; at other times it involves more subtle shifts in work activity and employment setting. Such labor force flexibility will become even more crucial in the coming decades, as the bulk of the university professoriat reach retirement age at the very time that the pool of potential new recruits dwindles in size.

The special section of this Society Membership report focuses on employment mobility and career change and their impact on the flexibility of the physics labor force. The Society Membership surveys, which the American Institute of Physics initiated in 1979 and has conducted annually since, provide a unique opportunity to examine such career change. The database generated by the surveys was designed to be longitudinal; the same individuals were queried annually. By tracking scientists throughout their career cycle, from education through employment and on to retirement, we can examine not only the net effects but also the specific patterns and directions of change. Thus, for example, we are able to examine the characteristics of both those individuals who moved from academic into industrial employment and the much smaller but still relevant group of individuals who moved into academe from other employment spheres.

Preceding the special section, the report opens with a profile of the society membership in 1986. The initial discussion presents basic demographic and employment information, including a summary of the salary position of society members. Detailed data tables are presented in Appendix C. And, as always, we close the report with a glimpse of the distinctiveness of each of the nine member societies. (The American Geophysical Union has become the tenth AIP Member Society. Its membership was first surveyed in 1987 and will be the special focus of the next society membership report.)

MEMBERSHIP COMPOSITION

Drawn from numerous professions and geographic locales, the members of the nine AIP Member Societies are a diverse group. This section provides a snapshot of who they are, what they do and where they live.

Demographics

The composition of the societies has remained relatively stable over time. Members resident in the United States are predominantly white (90%), male (92%), and U.S. citizens (88%). Just under 10% are graduate students, and most of the remaining 90% already possess advanced graduate degrees. Slight shifts over time, however, can be noted. For example, although women remain underrepresented, the current 8% level reflects a small but significant gain of two and a half percent since 1979.

Figure 1 depicts the age distribution of society members in 1986. In comparison to five years earlier,

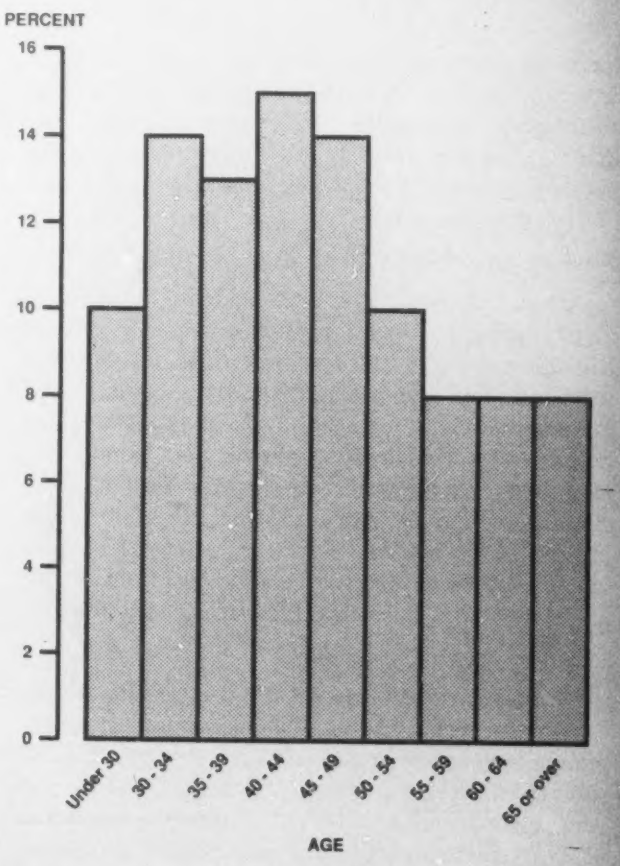

FIG. 1. Age profile of society members, 1986.

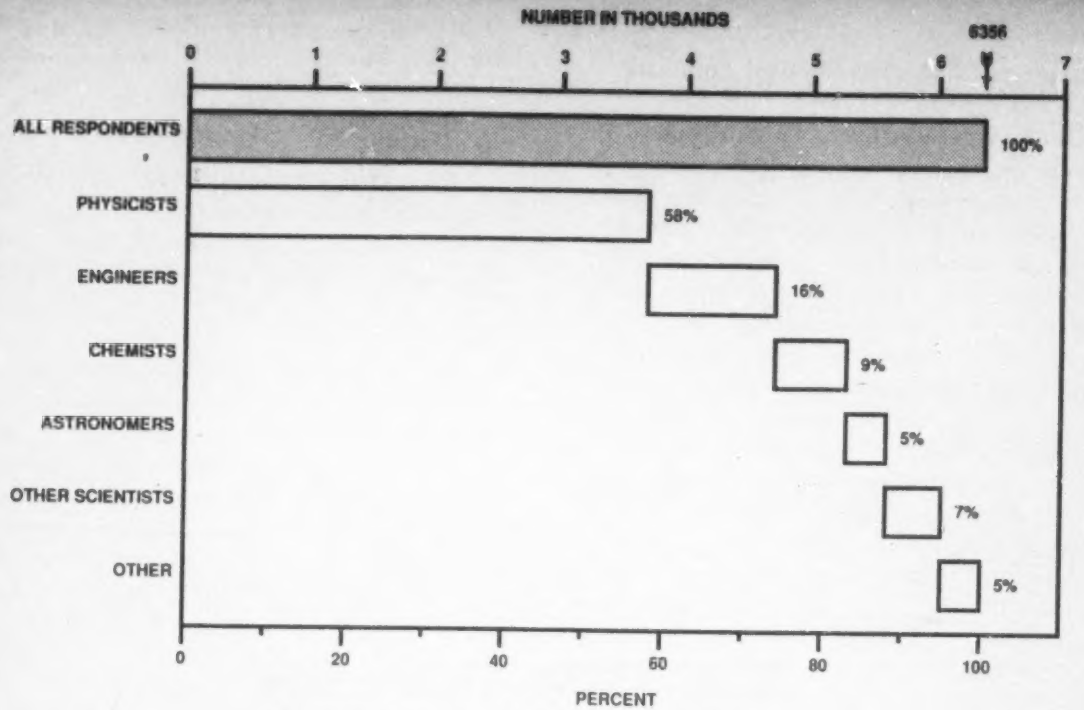

FIG. 2. Professional self-identification, 1986.

the membership as a whole has aged; that is, there are fewer members in the young age groups, and more in their late-40's and beyond. As a result, the overall median age has risen from 42 to 45. A stronger influx of young professionals will be needed in the coming decade to offset this trend.

Professional Self-Identification

By and large, society members identify themselves as physicists. However, engineers, chemists and astronomers are also well represented, as are scientists working in related disciplines. This is illustrated in Figure 2. In some of the societies, special groups such as psychologists, radiologists and educators have gained particular predominance, as discussed in the later more detailed section on individual society profiles. The breadth of the societies is further extended by non-scientists, a disparate group composed of physicians, patent attorneys, business administrators and the like.

Location

Society members can be found in all fifty states, though they tend to be heavily clustered in areas containing large urban or industrial centers. Figure 3 portrays the thirteen states (and District of Columbia) in which approximately three out of every four members reside. Areas in New England and the Middle Atlantic claim an especially high proportion, as do some of the Mountain and Pacific states. California and Massachusetts together boast one-quarter of all the U.S. members.

In addition to U.S. residents, the societies also claim a substantial foreign component; 15% of all members live outside the United States. The eight foreign countries, headed by Canada and Japan, that are most strongly represented are listed in Table I. With the exception of Canada, survey questionnaires are not mailed abroad. Therefore the remainder of this report will concentrate on those residing in the U.S. or Canada.

EMPLOYMENT

Scientific and engineering professionals remain active in the AIP Member Societies throughout their careers. Advanced graduate students, full- and part-time employees, and retirees all contribute to the vitality of the societies. Full-time workers, however, are by far the most prevalent, comprising over 80% of the membership. As in the past, members remain relatively unscathed by unemployment; only 1% of all individuals described themselves as not employed and seeking in 1986. Figure 4 illustrates the major employment sectors in which society members can be found. Broadly speaking, they are equally distributed among academic and non-academic settings, with university and industrial employment predominating. Government and the national laboratories also play an important role, ac-

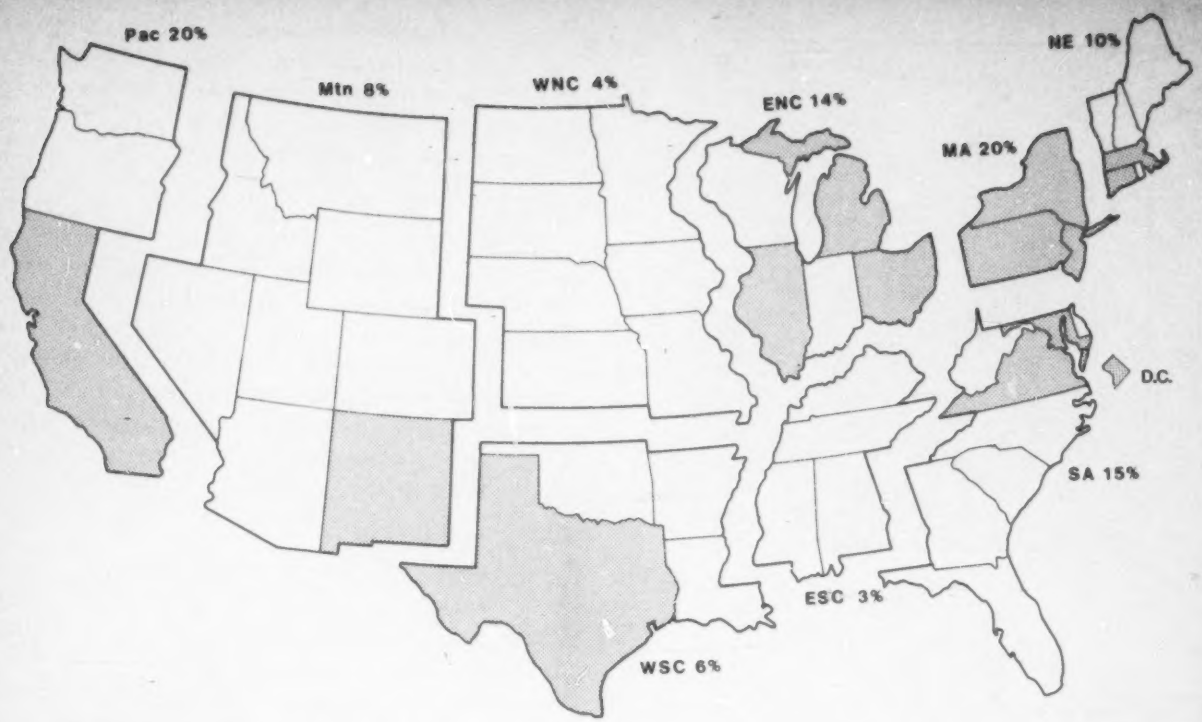

FIG. 3. Regional distribution of society members, 1986. Three-quarters of all members are concentrated in the shaded states.

counting for roughly one-fifth of all employment. This section briefly describes the five largest employment settings, highlighting the major activities and interests of individuals who work there.

University

Universities are the single largest employer of society members; in 1986 over one-third of all members were employed either full- or part-time at a university. Most held a tenured or tenure-line faculty appointment, while others were advanced graduate students and still others held non-tenure-line positions. As in the past, employment here remains the province of the PhD, with work centering around teaching and basic research. University employment further distinguishes itself by offering a wide breath of subfields; practically all physics subfields, from large areas such as solid state and elementary particle physics, to the less populated ones such as rheology, are taught, researched and studied here.

As illustrated in Figure 5, the university-employed are as a group the oldest society members. Past economic and demographic trends spurred a boom in academic employment in the 1960's, followed by a severe

TABLE I. Society members residing in selected foreign countries, 1986.

	Number
Canada	2089
Japan	1355
West Germany	941
England	646
France	557
Australia/New Zealand	483
Switzerland	414
Israel	332

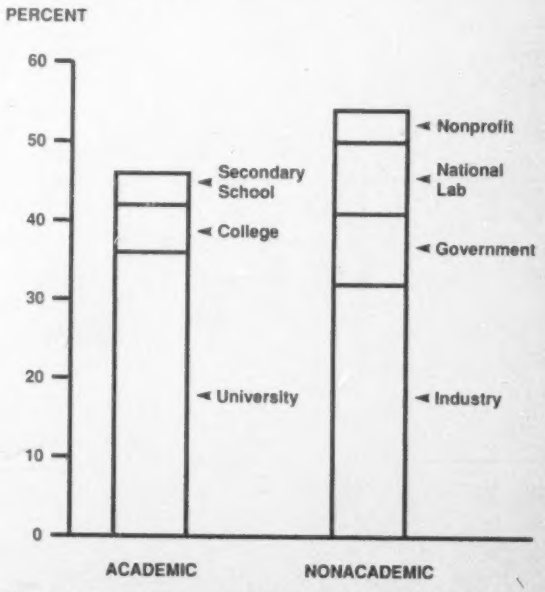

FIG. 4. Type of employer, 1986.

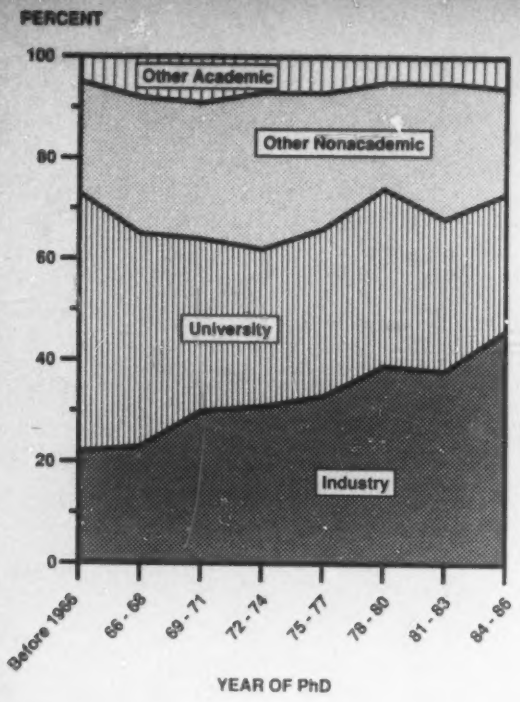

FIG. 5. Current employer type by year of PhD, 1986.

tightening of the market in the 1970's. Consequently, the bulk of the professoriat entered academe decades ago and is now over 50 years of age. Looking toward the 1990's, there may be a resurgence of academic employment opportunities as many faculty members reach the traditional retirement age.

Other Academic Settings

Roughly one in ten society members are employed in either a four-year college, junior college, or secondary school. Many are self-identified educators, trained in pre-college or college-level physics education, and are now involved in either teaching or administration. The majority have pursued advanced training and hold a masters degree. In contrast to non-academic and university employment, females are much more likely to be employed here than males.

Industry

Industry claims approximately one-third of all society members; over one-quarter of all PhDs, 40% of all masters degree holders, and two-thirds of all bachelors degree holders can be found in the private sector. Among PhDs, this proportion has increased in recent years in response to the dearth of academic openings

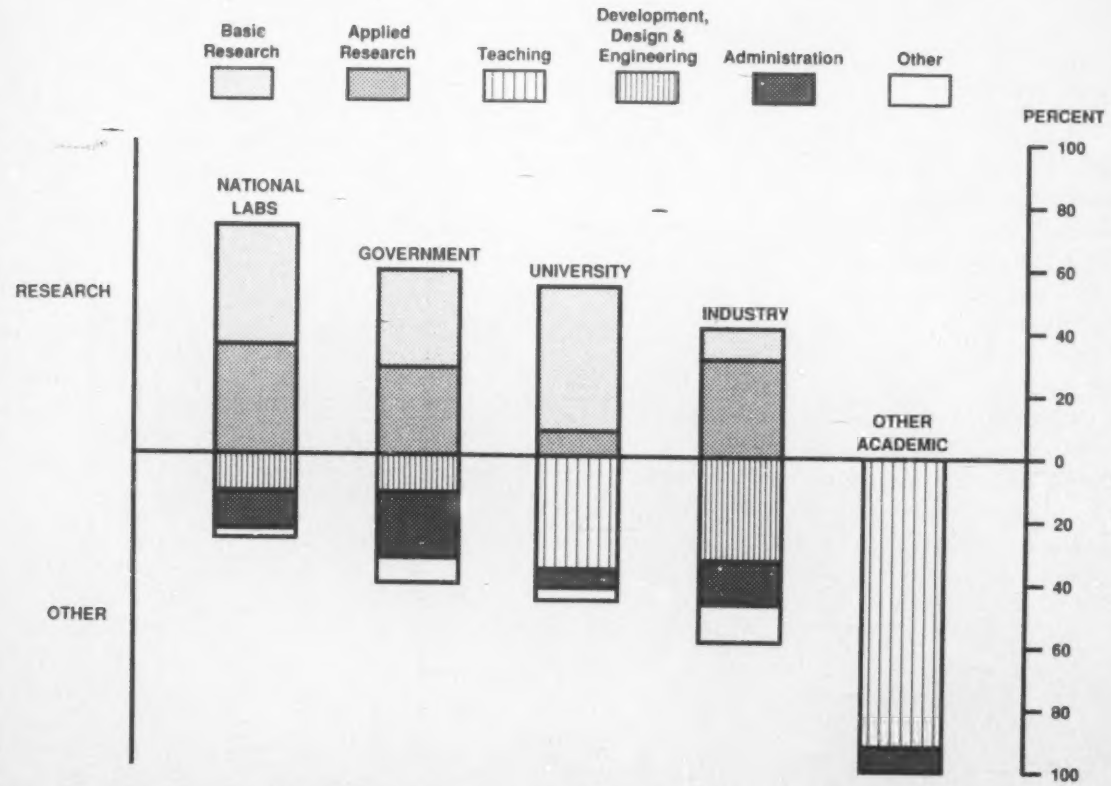

FIG. 6. Work activity by selected type of employer, 1986.

and the opportunity for financially rewarding industrial careers. The median age of the industrially employed is therefore well below the median age of society members overall.

As a general rule, industrial work is product- or service-oriented. Consequently, the primary activities most often cited by the industrially employed include applied research, development and design/engineering. Basic research, although relatively rare in industry, is carried out by a small cadre of PhD-level physicists located at large research-based companies such as AT&T and IBM. The field of engineering engages one-quarter of the industrially employed, a far larger proportion than is found in the other major employment settings. Common physics subfields indicated by those in industry include optics and solid state physics.

National Laboratories

Nearly one-tenth of all society members are employed at a federally funded research and development center such as Brookhaven, Lawrence Livermore, Argonne, and Los Alamos National Laboratory. Like the university-employed, the professional staff at most national laboratories are predominantly PhD-level scientists who describe themselves as physicists or astronomers. They are primarily involved in basic and applied research, especially in the areas of plasma physics, solid state physics, nuclear physics, and elementary particles and fields. However, as in other employment settings, it is not uncommon for senior-level scientists to be involved in administration as well.

Government

Many society members are employed by the U.S. government, most notably by the departments of Defense and Energy, by the National Institute of Standards and Technology, and by NASA. Drawing equally from all degree levels, government employment spans a wide range of work activities, although basic research, applied research, and administration predominate. Along with university faculty positions and appointments to a national laboratory, government employment is one of the major settings in which scientists with an interest in astronomy and astrophysics can pursue their craft. Other subfields commonly identified by government employees include solid state physics, acoustics, optics and science administration.

SALARY OVERVIEW

Steadily advancing salaries combined with a record-low inflation rate made 1986 a positive year economically for society members. In March of 1986 the overall median salary for society members rose to $47,000. This represents a 7% increase from the previous year and is well above the 2.3% inflation rate observed during this period. At the same time, wide ranging variations in salary levels and salary increases existed in 1986. This section provides a brief synopsis of several factors which dictate salaries, factors such as highest degree, employment sector, geographic location, and primary work activity. For a more detailed presentation of the topic, please refer to this document's companion publication, 1986 Salaries; Society Membership Survey.

Salaries and Degree Level

In the early 1980's annual advances in the median salary reported by PhDs paralleled the inflation rate; take-home-pay remained flat despite increases in salary. 1983 marked a change in this trend. A slackening inflation rate meant that salary changes translated into real gains in take-home-pay. In 1986 this was especially pronounced: the median PhD salary grew at a rate three times that of inflation. Figure 7 illustrates the relationship between PhD reported salaries (labeled current dollars) and salaries adjusted for inflation (constant dollars) during this period.

Salaries for bachelors and masters degree recipients do not lend themselves as easily to analysis. Lower degree holders are under-represented in the membership, and those who are members tend to be atypical. Although caution must therefore be exercised when analyzing salary data for lower degree holders, several

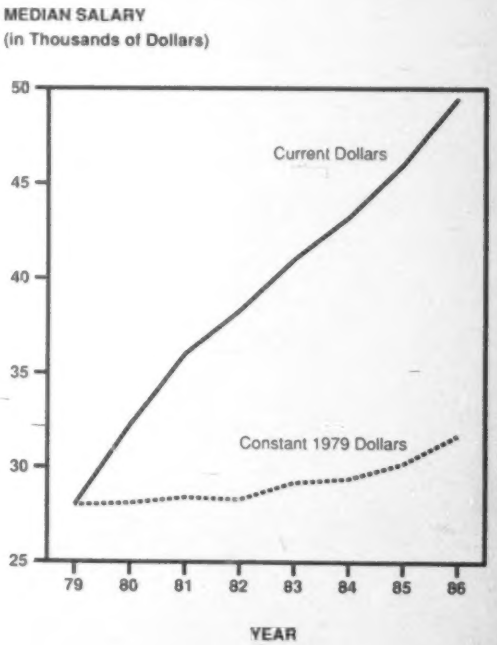

FIG. 7. Median salaries for PhDs, 1979–1986. Both reported salaries and salaries adjusted for inflation are presented.

points can be made. The large majority of society members holding a masters degree are employed either in industry or a secondary school. Whereas industrial salaries tend to slope upward with professional experience, secondary school salaries are lower and relatively flat. The disparity in median salaries observed between the two sectors, ranging from $11,000 for newly employed members to $24,000 for those with the most professional experience, is quite striking.

Salaries and Employment Sector

Length of professional experience is the most consistent determinant of salary: an individual's salary is directly proportional to the number of years spent in the labor force. Similarly, salaries vary widely from one employment sector to the next. Industrial employers, ranging in size from large corporations to small start-up firms, pay the highest salaries, followed by the national laboratories and government.

At all levels of professional experience industrially employed PhDs commanded higher salaries than those in other employment settings. In 1986, doctorates entering the labor force reported earning a median annual salary of $44,300 in industry. This is $2,300 more than starting salaries in the national laboratories and $7,300 more than those in government. The best paid industrial PhDs, those at the most advanced levels of experience, earned salaries of $100,000 and more in 1986.

High industrial salaries have created increasing pressure within the public sector to become more competitive. Historically, government employees have been paid at a rate well below industrial rates; in 1986 the median annual salary in government was $51,500, which is $4,500 lower than in industry. The percentage increases given to federal employees to correct the disparity have done little to narrow this gap.

Nearly half of all society members with a PhD work in academe. In general, the bulk of the academically employed work in universities, are somewhat older than their non-academic peers, and earn lower salaries than those outside academe. In 1986, overall median academic salaries ranged from $31,600 in 4-year colleges to $45,000 in universities. Figure 8 depicts the range of salaries by type of academic institution and academic rank.

Salaries and Geographic Location for PhDs

In 1986 median PhD salaries varied by as much as $8,000 across geographic divisions. By and large, salary differences between regions are due to variations in employer compositions. In areas dominated by industry, such as the Pacific and Mid-Atlantic states, median salaries are high, at or above the $50,000 per year mark. At the other end of the spectrum, a concentration of lower-paying academic jobs, as in the West North Central, tends to suppress the division's median annual salary.

Figure 9 presents median salaries for PhDs in 12 metropolitan areas. Because the cost of living varies so much from one city to the next, both actual salaries and

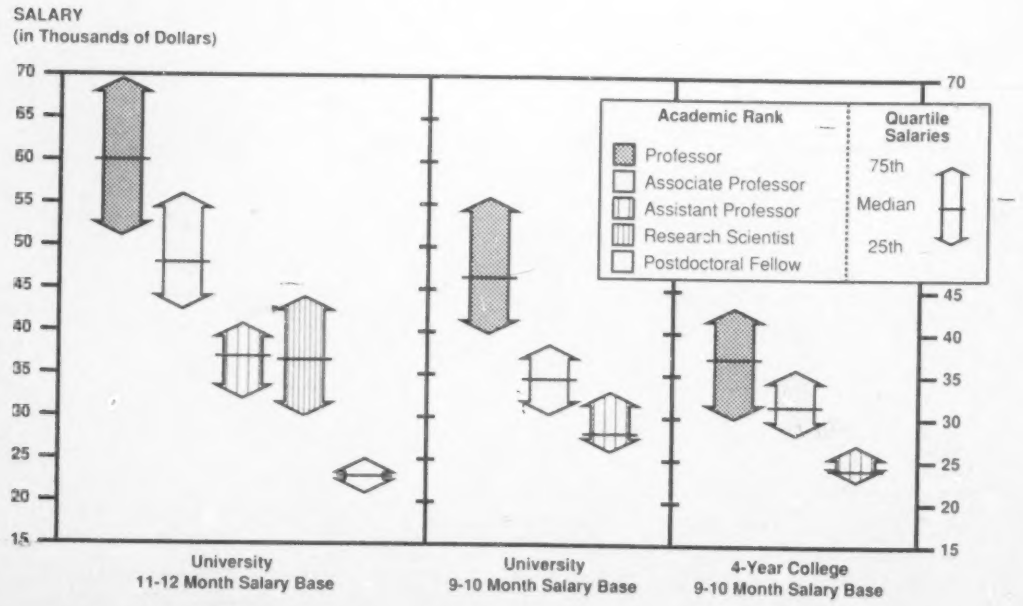

FIG. 8. University and 4-year college salaries for PhDs by academic rank, 1986.

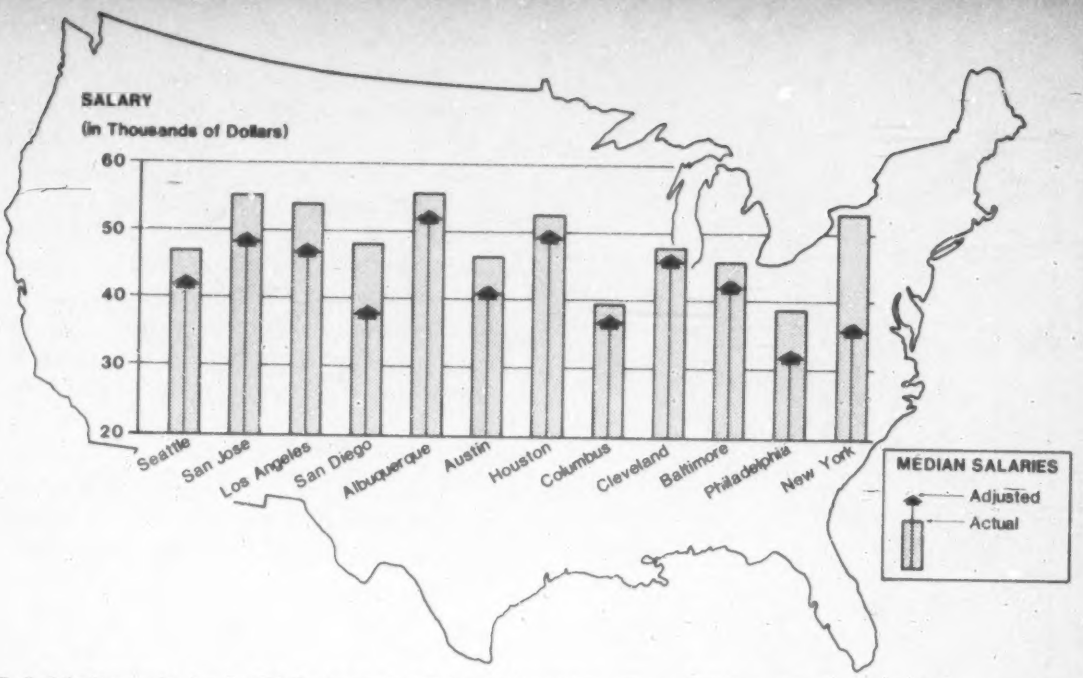

FIG. 9. Median salaries for PhDs in each of 12 metropolitan areas, 1986. Both actual salaries and salaries adjusted for cost of living are presented.

salaries adjusted for local cost of living are presented. In general, society members reside in larger, more expensive urban centers where physicists with advanced training are more likely to find employment opportunities. As a consequence, all of the cities depicted in Figure 9 have a higher cost of living index than the national average. Of the U.S. cities for which data are available, New York, Philadelphia and Los Angeles remain among the most expensive.

Salaries and Primary Work Activity

Society members are involved in a wide range of work activities. Regardless of their work activity at entry-level, PhDs who accept industrial employment earn similar salaries ($40,000–$48,000). The earnings of those doing applied research, for example, are on par with the earnings of those engaged in basic research, development, and design/engineering. Comparable salaries are maintained across these work activities as professional experience increases. The major exception is administration; mid-career shifts into administration are very profitable, with median salaries substantially higher than those in non-administrative areas.

SPECIAL SECTION: EMPLOYMENT MOBILITY AND CAREER CHANGE

INTRODUCTION

The special focus of this society membership profile is on changes that occur during the development of an individual's professional career. Becoming a scientist or engineer and carrying out one's profession involves a myriad of choices, of directions pursued and others disregarded. Some of the changes involved are major and dramatic; others are subtler shifts occurring in the transition from one stage in career development to another. Our aim here is to describe the nature of these changes, determine when they are most likely to occur and then examine the factors which are most directly related to the changes observed. The information derived from this analysis should provide us with some insight into both the typical patterns of career development and the new career options which are only beginning to emerge.

The longitudinal surveys of the membership of the AIP member societies provide a unique opportunity for examining career change. The following discussion traces individuals through the first half of the 1980's, noting changes in employment as they occur. The focus of the analysis will be on three phases of a scientific career: 1) the early employment period, elaborating on experiences during the first six years following receipt of the PhD, 2) the extended mid-career span after many initial career decisions have been implemented, and finally, 3) the late career period when retirement options loom in importance. Attention is primarily directed to the career paths followed by PhDs.

The Early Employment Period

The most frequent and most dramatic changes occur early in an individual's professional career. Figure

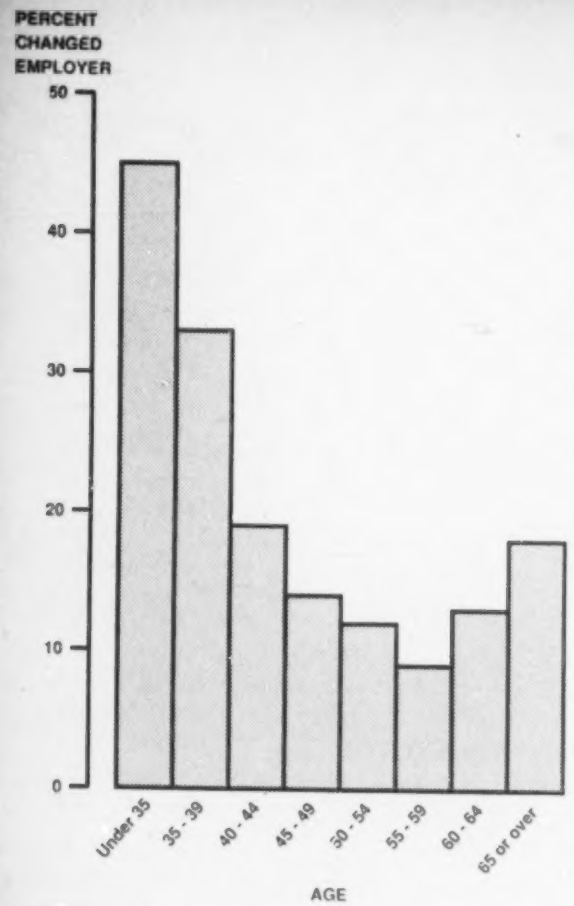

FIG. 10. Level of employer mobility between 1981 and 1985 for different age groups.

10 illustrates, for example, the variation in employer mobility by age. The first several years following the PhD involve a broad range of decisions and shifts in activity. Will one accept a temporary postdoctoral position or enter regular, potentially permanent, employment? Will one remain in academe or move into industry, government or the national laboratories? Will one continue research in one's dissertation area, move into another area of research or become involved in a broad variety of non-research activities? In recent years, with the dramatic increase in foreign graduate students studying physics in the United States, another major decision emerges in this early post-PhD period. Will one return to one's home country, remain in the U.S. on a temporary visa as a postdoc, or obtain permanent visa status and employment? In addition to describing these different patterns in the opening discussion below, we will be looking at some of the characteristics that distinguish the individuals who choose these different paths early in their careers.

The Mid-Career

During mid-career the changes observed may not be as dramatic as they are in the early stages. However, as part of the normal career development process, shifts in employer, work responsibilities, research fields and academic rank continue to occur. It is this ability to make changes which provides the scientific labor force with its flexibility and its responsiveness to shifts in demand. Occasionally, correlated with these changes, we also observe more basic alterations in professional self-identification. The second section will concentrate on these continuing career developments.

The Late Career Years

Finally, at the end of one's career, many decisions revolve around retirement. With a relatively large number of academic scientists nearing the traditional retirement age in the mid 1990's, considerable interest has developed regarding the timing of that retirement. University administrations evaluating future staffing needs are interested in determining the number of faculty who are likely, on the one hand, to take early retirement options and, on the other hand, to remain to age 70 or beyond. The removal of any mandatory retirement age is expected to be extended to the academic sector in 1994. Our longitudinal analysis looks at current patterns of retirement both in academe and in other sectors of the economy. From the perspective of the individual, retirement is frequently a multi-stage process. New forms of work involvement may precede full retirement. Second careers with a new employer in a different economic sector are not uncommon; even more typical is the shift into part-time employment. From the perspective of the employer, however, it is the initial retirement decision which is likely to have the greatest economic impact. Both perspectives will be discussed in the final part of this special section.

EARLY CAREER CHANGE

Many of the most dramatic changes in a scientist's career occur shortly after receipt of the doctoral degree. To analyze the nature of these early career changes in some detail, we examined the employment routes followed by society members who received their doctorates between 1978 and 1981. Figure 11 illustrates the diverse employment positions initially selected by these recent PhDs: temporary postdoctoral, potentially permanent academic, industrial, government and national laboratory. In the following discussion we examine the characteristics of these groups as of 1981 and the paths they traveled during the ensuing four years.

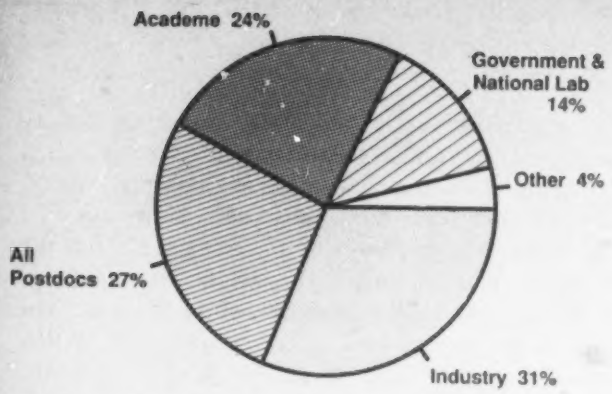

FIG. 11. Initial employment of recent PhDs, 1981.

The Postdoctoral Route

Postdoctoral positions are traditionally entered by PhDs planning academic or other basic research careers. Although remuneration is low, these positions allow individuals to expand their research skills, to follow up on their dissertation work, and to develop new basic research interests. Equally important, the young PhDs are freed for a few years from teaching and administrative responsibilities. Postdoctoral positions are primarily based in universities, although a small number, representing about one-quarter of such positions, can be found in the national laboratories and, to a lesser extent, government and industry.

Due to the temporary nature of the postdoctoral position, individuals who followed this path were the most likely to have made employment changes by 1985. Focusing on the academic postdocs, one can note from Table II that only about a quarter of these PhDs were still working for the same university in 1985; this small group was most likely to still be holding postdoctoral or soft-money research associate positions. In contrast, between two-thirds and three-quarters of the PhDs who started employment in other sectors had remained with the same employer.

Slightly over one-third of the original postdoctoral group had moved to another university; most of them had located tenure-line positions. These universities were likely to be somewhat larger than the academic institutions at which individuals who skipped the postdoctoral step were located. However, controlling on size, these universities did not appear to be any more prestigious. Finally a substantial group of postdocs had left the academic sector completely; their primary destination was industry.

Despite the extensive movement between employers, a high proportion of those who initially take a postdoctoral appointment remain in physics and continue their involvement in basic research. As Table III indicates nearly 60% of the total group of 1981 postdocs were still primarily engaged in basic research four years later. This heavy involvement in research held true both for those PhDs who remained within the academic sector and for those who moved into non-academic employment. Most of them (three-quarters) also continued to be involved in physics and, in fact, almost 70% of them were still working in their dissertation subfield. These proportions are considerably higher than found among the PhDs who did not follow the postdoctoral route. The minority of postdocs who had shifted their work activities after completing their postdoctoral position were teaching, if they remained within the academic sector, or had become involved in applied research, design and engineering if they entered one of the non-academic sectors.

A final note should be made concerning the individuals who selected the postdoctoral route. They differed from the other PhDs in several respects. Their dissertations were somewhat more likely to have been in the areas of astrophysics or elementary particles and

TABLE II. Employer mobility between 1981 and 1985 of recent PhDs.[a]

	1981 Employer				
1985 Employer	Academic-Postdoctoral %	Academic-Employment %	Industry %	Government and National Laboratories %	Overall[b] %
Same Employer	28	64	74	64	59
Different Employer					
Same Sector	37	20	17	9	20
Different Sector	35	16	9	27	21
Total Number Known	71	85	107	48	326

[a] Based on individuals who received their doctorates between 1978 and 1981.
[b] Includes those employed in other employment settings.

TABLE III. 1985 basic research involvement by 1981 postdoctoral status, recent PhDs.[a]

1985 Work Status	1981 Status: Postdoctoral %	1981 Status: Non-Postdoctoral %
ACADEMIC		
Basic Research	35	13
Other Work	22	22
NONACADEMIC		
Basic Research	23	12
Other Work	20	53
Total Number Known	94	255

[a] Based on individuals who received their doctorates between 1978 and 1981.

to be theoretical in nature. In addition, a slightly higher proportion of foreign citizens on temporary visas could be found in their midst. Of all society members who went from temporary to permanent visa status during this four year period, nearly 40% were holding postdoctoral positions in 1981; all but a few of them had moved into regular employment by 1985. In addition to its other functions the postdoctoral position is apparently being utilized as a bridge to more permanent U.S. employment by a number of foreign citizens.

Direct Employment in Academe

Although the postdoctoral route is a popular one for many new PhDs, a similar number of young society members begin their academic employment directly in tenure-line positions. Most of them enter universities and four year colleges at the assistant professor level. While some of these PhDs continue the basic research they were involved with during their dissertation years, their primary concentration is focused on teaching.

What was the nature of the early career experiences for the PhDs who in 1981 had directly entered academic employment? By 1985, fully 84% of them were still employed in academe, a considerably higher proportion than among those who had followed the postdoctoral route. In fact nearly two-thirds of them were working at the same academic institution during those years, while others had shifted to another college or university. Teaching continued to play the central role in their activities.

Only a small group of these PhDs left academe. They were headed primarily for industry, where they became involved with a broad variety of work activities led by applied research. In the process of making this move their salaries doubled.

New PhDs who follow the direct route to academic employment, rather than the postdoctoral route, are thus more likely to remain in academe, but they are less likely to focus on basic research.

Initial Industrial Employment

A large number of new PhDs among the society members, one-third of the total, go directly into industrial employment. It is within this group that we find the most dramatic of the early career shifts. As they enter industrial employment, these young PhDs make a number of basic changes. They are drawn from a wide variety of dissertation subfields, with solid state, nuclear and plasma physics predominating. However, relatively few of them, about one-third, continue to work in their dissertation area once they enter industrial employment. In fact, nearly one-half of them work in areas outside of physics altogether, primarily in engineering.

The work involvement of these industrially employed PhDs was diverse. About half of them worked for just 18 large companies including Bell Laboratories, IBM, and TRW. The rest were distributed among scores of smaller companies. Only a small number of individuals, even in the largest of companies, were concentrating on basic research. As indicated in Table IV the major attention was focused on applied research, development, design and engineering. While only about one-third of the physics PhDs employed in industry are working on government contracts, it is the Department of Defense which provides three-quarters of that funding.[1] The salaries which these young PhDs commanded in 1981 were considerably higher than those obtained by PhDs beginning in any other employment sphere.

For the new PhDs who start off in industrial employment, their early career years involve both stability and change. By 1985 over 90% of them were still employed in the industrial sector; most of them, in fact, remained with the same company.

Although there was only a modest amount of mobility between employers for these young industrially employed PhDs, there were a number of shifts in work activity. One-third noted changes during the four year period. The major shift was from applied research to development, design and engineering. There was also some minor increase in administrative responsibilities, an involvement which would become more predominant in the mid-career years. Salaries, too, were increasing, on an average of 10% a year.

Industrial employment thus entails a substantial number of changes for new PhDs: a departure from the academic environment of graduate school and entrance to a quite different sphere, a move away from

[1] Unpublished NAS data.

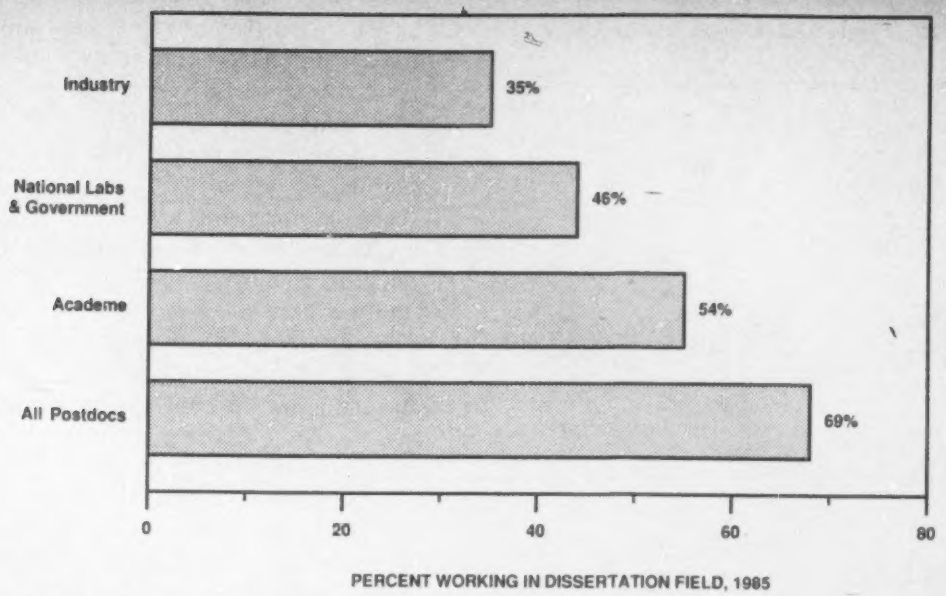

FIG. 12. Continuation in dissertation subfield through 1985, recent PhDs. This figure is based on those who received their doctorates between 1978 and 1981.

their dissertation concentration, an involvement with a diversity of new work activities, and sizable yearly increases in salary.

Government and the National Laboratories

A small group of recent PhDs start their careers in the government and the national laboratories, working at such places as the Naval Research Laboratory, Brookhaven and Argonne National Laboratory. A high proportion of them, about 70%, were involved in physics research, although not necessarily in their dissertation area as indicated in Figure 12. While the focus was primarily on applied research, fully one-third were concentrating on basic research.

Four years later little change could be observed in the work activity distributions of the young PhDs who started out in the government or a national laboratory; most of them were still heavily involved in applied and basic research. Over one-third of them, however, had changed employers, primarily moving into industry or returning to the university sector.

TABLE IV. Primary work activity of recent PhDs employed in industry, 1981.[a]

Work Activity	%
Applied Research	54
Development, Design and Engineering	26
Basic Research	15
Administration	5
Total Number Known	107

[a] Based on individuals who received their doctorates between 1978 and 1981.

MID-CAREER CHANGES

While the most dramatic changes typically occur early in a scientist's professional life, continuing shifts in work involvement take place throughout the mid-career years. Some of these shifts have an additive effect, culminating in a major redirection of one's career. The following discussion will deal with the experienced labor force: those PhDs who received their degrees prior to 1978 and were employed full-time in 1981 and 1985. The focus will be on the changes in employment which occurred during the intervening four years.[2] For a discussion of society members who left the labor force during this period see the final section on retirement.

As Table V indicates, the experienced labor force was almost equally split between academic and non-academic employment in 1981. University employment predominated in the academic sector, with only a small number of PhDs located in the four and two year colleges. In the non-academic sector, employment was more diversified; while industrial work predominated, a significant number of PhDs were also working in government, the national laboratories and non-profit organizations.

Employment stability is typical of the professional career in the middle years. During the four year period under study, only a small proportion of the experi-

[2] There were a few older postdoctoral position holders in the group who received their doctorates prior to 1978, but since postdocs were discussed in some detail in the previous section they will not be dealt with here.

TABLE V. Type of employer for PhDs in the experienced labor force, 1981.[a]

	%
ACADEMIC	49
University	42
Other Academic	7
NONACADEMIC	51
Industry	23
Government	11
National Laboratories	12
Non-Profit and Hospitals	4
Other[b]	1
Total Number Known	2491

[a] Based on individuals who received their doctorates prior to 1978.
[b] Includes the self-employed and those working in other employment settings.

enced labor force changed employers, 15%. As Figure 13 indicates, PhDs working in the universities and the national laboratories were least likely to leave their place of employment while PhDs working in industry were the most likely to make such a change. Even in a basically stable environment, however, some shifts and changes do occur.

Academic Employment

PhDs in the experienced academic labor force are among the most likely to remain with the same employer. This is particularly true in the university environment, where a large core of older full professors dominate the scene. By 1985 the median age of the continuing academic labor force was 50; seventy percent were full professors. The only significant moves out of the upper levels of the professoriate were through retirement.

The relatively small group of individuals who changed employers was considerably younger at 44 and was drawn heavily from the lower paid assistant professor ranks. Whether they moved to another university or left the academic sector completely, their financial situation improved markedly. By 1985 they were earning higher salaries than their considerably older non-mobile colleagues.

As indicated in Table VI, the majority of those who left university positions departed academe. Their primary destination was industry, a move which typically entails major changes in subfield concentration and a shift from basic research and teaching to applied research, development and design. Such moves also involved a major change in financial status, with the salaries of the recruits from academe to industry more than doubling over the four year period.

The most frequent changes for PhDs remaining within the academic sector involve shifts in academic rank, as indicated in Table VII. During the four year

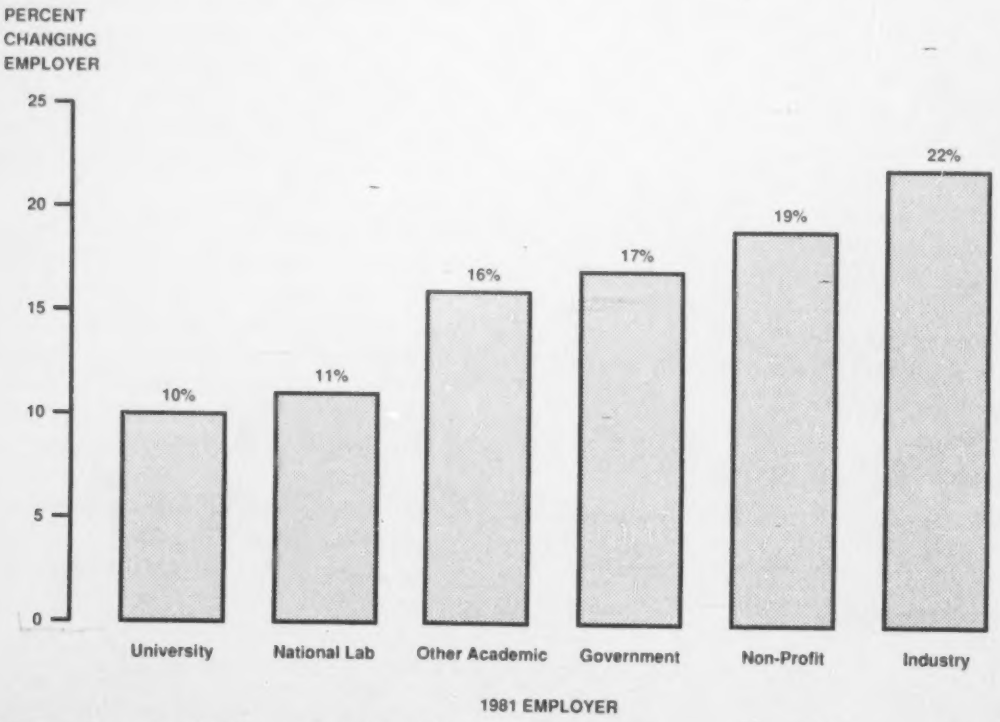

FIG. 13. Employer mobility between 1981 and 1985 for PhDs in the experienced labor force. Mobility is presented for each of six employment settings.

TABLE VI. Type of employer movement between 1981 and 1985 for mobile PhDs in the experienced labor force.[a]

1985 Movement	1981 Employer						
	University %	Other Academic %	Industry %	Government %	National Laboratories %	Non-Profit %	Overall[b] %
Within Sector	46	15	73	45	12	18	48
Out of Sector	54	85	27	55	88	82	52
Total Number Known	108	26	125	46	32	16	362

[a] Based on individuals who received their doctorates prior to 1978.
[b] Includes those employed in other employment settings.

period under study one-third of the associate professors moved up to full professor, and one-half of the assistant professors were promoted to the associate level or above. Only among assistant professors and the non-tenure line ranks do we see any marked departure from academe.

Non-Academic Employment

The experienced non-academic labor force, with the exception of individuals employed at the national laboratories, appears to be considerably more mobile than the academic labor force we have just described. During the four year period under study, about one-fifth of the PhDs working in industry, government and non-profit organizations changed employers. In general, most of this mobility was across employment sectors. A different pattern, however, could be observed in industry. Here, individuals were most likely to move from one company to another; relatively few actually left industrial employment.[3]

[3] It should be noted that a small portion of this mobility may have been movement within the same large company, particularly when companies were undergoing merger and takeover battles which made stable classification difficult.

Industry. Industrial employment involves not only a relatively high level of employer mobility, but also shifting patterns of work involvement. As Table VIII indicates, those PhDs who remained with the same employer during the four year period from 1981 to 1985, showed a modest shift away from research activities, predominantly applied research, to development, design, engineering and administration. The shift was much more pronounced for those PhDs who went to work for a different company (Table IX). One half of this mobile group had been involved in research in 1981; by 1985, at their new place of employment, only about one-third were so engaged. This shift in work activity was also predominantly into development, design and engineering.

Shifts in work fields also continued to occur but they were minimal in comparison to those made during the initial years of industrial employment. About two-thirds of the experienced PhDs were working in physics in both 1981 and 1985, while the remainder were primarily engaged in engineering. For a very small group of physics PhDs, however, these shifts in work activity and field culminated in a more fundamental career change, a change in their professional self-iden-

TABLE VII. Academic rank mobility between 1981 and 1985.[a]

1985 Status	1981 Academic Rank			
	Full Professor %	Associate Professor %	Assistant Professor %	Other Ranks %
Remained in Academe				
Same Rank	97	60	33	65
Higher Rank	-	33	51	19
Left Academe	3	7	16	16
Total Number Known	678	265	109	100

[a] Based on individuals who received their doctorates prior to 1978 and were employed full-time in both 1981 and 1985 in universities and four-year colleges. See the final section for discussion of movement into retirement.

TABLE VIII. Work activities of PhDs remaining with the same industrial employer between 1981 and 1985.

Work Activity	1981 %	1985 %
Research	55	50
Development, Design & Engineering	27	31
Administration	18	19
Total Number Known	441	441

tification. They no longer perceived of themselves as physicists.

Changes in professional self-identification are relatively rare phenomena among society members; less than 5% of our longitudinal sample of experienced PhDs made such changes during the 1981–85 period. This, of course, should be seen as a minimal estimate. As individuals' ties to physics become more tenuous they are more likely to drop society membership and to affiliate with organizations which more directly reflect their new interests. (See Appendix A on dropping society membership.) However, when such changes do occur among society members they are closely linked to industrial employment. In our sample, half of the PhD physicists who made these most radical of career changes had either been employed in industry in 1981, or had moved into industrial employment during the 1981–1985 period. Most frequently these pivotal changes were preceded by a series of shifts in work involvement; over half of these individuals had been working outside of physics for at least four years before they made the change in professional identification.

Leaving Industry. The relatively small number of PhDs who left the industrial sector moved in several very different directions; about one-quarter each entered the academic sector, the government or became self-employed. The remainder moved to the national laboratories and non-profit organizations. Although these groups are too small to analyze in any detail, a couple of general comments can be made. Those PhDs who entered academe were older than the remainder of the experienced industrial labor force. Many of them had been working outside of physics when they were in industry. On their move to a university they resumed their involvement with physics and were now more likely to be engaged in teaching than research. Those who went into the national laboratories, a much younger group, had been more heavily involved in physics research than the typical industrial employee; they maintained that research involvement when they moved to the national laboratories. They also commanded high salaries, comparable to the ones they had earned in industry.

TABLE IX. Work activities of PhDs changing industrial employer between 1981 and 1985.

Work Activity	1981 %	1985 %
Research	50	34
Development, Design & Engineering	30	48
Administration	20	18
Total Number Known	90	90

Government. PhDs working in the government were somewhat less likely to change employers than PhDs working in industry, as indicated previously in Figure 13. In addition, shifts in work activity were much less pronounced. Approximately two-thirds of those who continued working for the same government agency were involved with research both in 1981 and 1985. Research involvement was considerably lower for those who changed agencies or left the government entirely. In 1981 only 40% of this mobile group were engaged in research. This low level of research involvement persisted after the PhDs moved into other spheres of employment. Perhaps the most interesting findings regarding government employees were the work activity patterns in 1981 of those who later changed employers (see Figure 14). Individuals who moved to another government agency were considerably more likely than those who remained with the same agency to come from the ranks of design, development and engineering workers. Those individuals who left the government sector entirely were drawn heavily from the administrative ranks, a work involvement they discarded when they moved into university teaching and industrial development, design and engi-

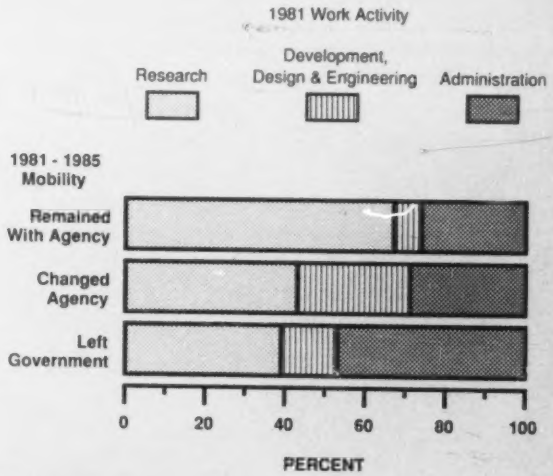

FIG. 14. Mobility between 1981 and 1985 of experienced PhDs in government by their initial work activity in 1981.

neering work. Such selection patterns were not noted among those who left any other employment sector.

National Laboratories. Experienced PhDs working at the national laboratories, e.g., Brookhaven, Argonne, appear to be as unlikely to change employers as their older university colleagues. Only 11% made such a move during the four year period under study. Nearly three-quarters of the PhDs who remained at the laboratories worked in research in 1981 and continued to do so in 1985. Among the various employment sectors, this was the highest level of research involvement, albeit most frequently applied research. Very few PhDs moved from one national laboratory to another, a reflection of the quite different research emphases to be found at many of the national laboratories. The small group which did depart the national laboratories was headed either for industrial or, to a lesser extent, university employment. As Table X indicates this change in employer brought about major shifts in work activities.

As the above discussion has indicated changes during the mid-career years are not as typical as they are during the early years following the receipt of the PhD. This is particularly true for individuals involved in research at the universities and the national laboratories. Once they have become members of a tenure-line faculty or permanent laboratory staff their careers tend to stabilize. Careers in industry, government and the nonprofit sector appear to be more flexible. Moves from one company or agency to another and even to different sectors of the economy occur with some frequency. Industrial careers are also typified by continuing shifts in work activities.

RETIREMENT AND LATE CAREER MOBILITY

As scientists' professional careers wend their way to a close, decisions regarding retirement assume increasing importance, both for the scientists, themselves, and for the universities, companies and laboratories where they are employed. For the individual scientists, retirement decisions will set the framework for their professional involvement and life style throughout the later years, a period now extending for a decade, on average, beyond the traditional retirement age of 65. For the employer the decisions will also have an important impact. Individual retirement plans of today will effect an institution's staff openings, levels of available expertise, salary structures and employment opportunities for decades to come.

TABLE X. Work activity of PhDs leaving the national laboratories between 1981 and 1985.

Work Activity	While Employed in a National Lab, 1981 %	After Leaving a National Lab, 1985 %
Research and Teaching	69	48
Development, Design & Engineering	9	29
Administration	22	23
Total Number Known	27	28

Retirement may be described best as a process rather than a discrete event. Planning and consideration of different retirement options frequently start in the mid-career years. For many the move will be from full employment to full retirement. For an almost equal number, however, full retirement is preceded by part-time or alternative full-time employment. The following discussion will focus on all three types of retirement-related moves. In conducting this analysis, we looked at all individuals in the longitudinal sample who made such moves at any point between 1980 and 1986, a somewhat broader period than presented in the earlier parts of this special section.

Full retirement. Our initial discussion deals with those individuals moving directly from full-time employment to retirement. Perhaps one of the most frequently raised questions is: when do people retire? In the U.S. labor force as a whole, the median age of retirement has been steadily decreasing as the availability of benefits at younger ages becomes more widespread.[4] For our sample of scientists and engineers, however, 65 remains the median age of retirement. But such a summary statistic covers some very divergent retirement practices. In fact, only about one-third of society members retiring during the first part of the 1980's retired at age 65.[5] A higher proportion, forty percent, opted for early retirement, while the remaining 30% extended their employment beyond the traditional retirement age of 65. The timing of retirement in large part reflects the employment sectors from which an individual is retiring, as Figure 15 illustrates.

Only within the university sphere is delayed retirement an important element in the retirement process. In all other spheres early retirement is making major inroads. Although the sample numbers are too small to disaggregate further than that illustrated in Figure 15, it can be stated that the earliest retirement occurs from the government and the secondary school system.

For many professionals, however, retirement is not a straightforward move from regular full-time employment to total retirement. Rather a multi-stage process

[4]Ricardo-Campbell, R., Ed. (1987), Issues in Contemporary Retirement, Hoover Institution Press, Stanford, California.

[5]The range 64–66 is used as an approximation of age 65.

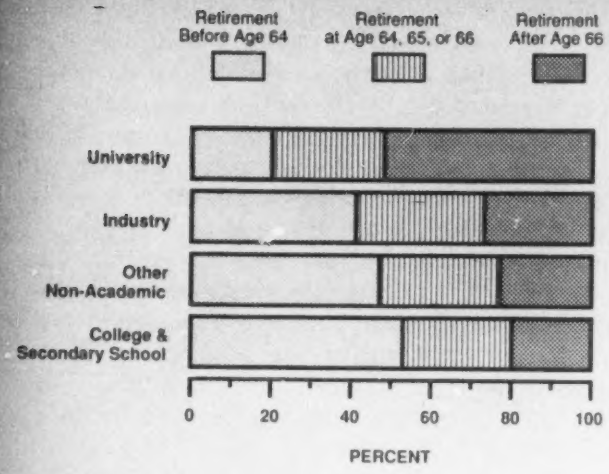

FIG. 15. Retirement in the 1980's by age and employment sector. This figure depicts movement from full-time employment to retirement.

is involved. Nearly half of the society members choose these more indirect routes as indicated in Table XI. Some individuals move into part-time employment, while others opt for new full-time positions. From an individual perspective, part-time and new full-time employment are alternative options to full retirement. From an institution's perspective, these moves frequently free staff positions in the same manner as more standard retirement moves do. And for the new employer, older mobile scientists represent a rich source of needed expertise. The remainder of this section examines these alternative forms of late career mobility in more detail.

Part-time employment. Movement into part-time employment can, of course, occur at any point in one's career. Here we will be examining only those moves which occur at age 55 or later, when they are most likely to represent a pre-retirement option. Table XII

TABLE XI. The retirement process in the 1980's.[a]

	%
Full-time to Retirement	55
Full-time to Part-time	26
Full-time to New Full-time	19
Total Number Known	431

[a] In this table, the category "Full-time to Retirement" includes all age groups. "Full-time to Part-time" employment refers to those aged 55 or older. "Full-time to New Full-time" employment refers to those aged 60 or older.

indicates the pattern and timing of these later career changes from full to part-time employment. As expected, these changes occur at an earlier age than the direct moves into retirement. For university employees little actual movement occurs. Most of them tend to remain with the same institution, but in a position with fewer responsibilities. A small number move to other universities; virtually none leave the academic sector completely.

A different picture emerges for those changing from full-time industrial employment. While many remain with the same company on a consulting basis, others move into self-employment. A few assume part-time academic positions. The duration of these part-time positions vary from one to several years. The final move from part-time to total retirement tends to occur when individuals are in their late 60's and early 70's.

Full-time employment. Major job changes involving full-time employment shifts, although less typical, also occur towards the end of a professional career. They are more difficult to measure clearly and to distinguish from regular mid-career moves. As a pre-retirement option, we will consider only those full-time employment shifts which are made at the age of 60 or later. Even with this more restrictive definition, it is of interest to observe from Table XIII that these shifts in

TABLE XII. Full- to part-time employment change for individuals aged 55 and older.

	Full-time Employer			
Part-time Employer	University %	Industry %	Other Non-Academic %	Overall[a] %
Same Employer	85	51	77	68
New Employer				
Same Sector	10	7	6	10
Different Sector	5	42	17	22
Total Number Known	33	35	35	111
Median Age	65	63	62	63

[a] Includes individuals who were employed full-time in other academic spheres.

TABLE XIII. Full-time employment changes for individuals aged 60 and older.

New Full-time Employer	Initial Full-time Employer			
	University %	Industry %	Government %	Overall[a] %
Same Sector	55	60	46	52
Different Sector	45	40	54	48
Total Number Known	15	27	19	81
Median Age	65	61	63	62

[a] Includes those individuals who were initially employed in other employment spheres.

full-time employment occur at a somewhat younger age than the moves into part-time employment previously discussed, and considerably earlier than moves into full retirement.

Although these moves occur in all employment sectors, they are most prevalent in industry and government. The mobility among the older society members employed in industry is primarily from one company to another and secondarily into self-employment. Although we had earlier observed a few individuals leaving industrial employment for part-time academic employment towards the end of their careers, we found no one in our small sample making such full-time moves. For the older government workers full-time employment changes involved agency shifts and some minor movement into the academic and industrial sectors.

Retirement is thus not always a simple, clear cut action. As a large number of physicists approach the traditional ages of retirement in the 1990's, institutions and individuals will need to consider both the opportunities and the problems presented by the different available options which we have briefly touched on above. This is particularly true in academe. The university professoriat has, through the first half of the 1980's, been a very stable group, retaining their full-time positions to relatively advanced ages and remaining at the same university even when they do make shifts into part-time status. Whether new patterns will emerge as the older faculty swells in number will depend heavily on university retirement and benefit policies, many of which are already undergoing changes, and alternative opportunities for part and full-time employment. Further research in these areas is needed to determine what factors are most important in influencing individuals to follow one or another of the different paths to retirement.

CONCLUDING REMARKS

As the competitive needs and new opportunities of the 1990's and the impending 21st century sweep in upon the scientific community, increased attention will turn to strengthening the human resource base upon which the community is founded. New recruits, both foreign and U.S., will be sought to satisfy industrial demand and to fill the academic positions vacated by a retiring professoriat. The shrinking pool of traditional college age students, the persistent underrepresentation of women and minorities, and the shaky state of preparatory science and mathematics education will make that search an arduous one for the physical sciences.

PhD scientists are, perhaps, the most fragile element in that resource base. Their training is complex and lengthy, dependent at each stage on success at previous levels. Sudden peaks in demand cannot be addressed by overnight production. Even stable demands can go unmet if seepage from the pipeline suddenly increases due to economic or other circumstances.

Until major inroads are made in developing a broad pool of educated youth, the health of the scientific enterprise will depend heavily upon the flexibility of its current doctoral labor force. The preceding special section of this report has provided us with the opportunity to examine the nature of this flexibility in some detail, noting both the strengths and the limitations which exist.

In the industrial sphere we have seen the greatest evidence of an open and resilient labor force. Individuals enter industrial employment from many different points: immediately following the PhD, after a post-doctoral fellowship, and after brief or prolonged work involvement in academic and non-academic spheres. The mesh of work activities are constantly shifting; the newer recruits typically focus for several years on research, and then frequently move into the development, design and administrative areas. Movement between companies is also common. The one element that is not predominant is any extensive involvement in basic research.

At the other extreme has been the relative inflexibility of the university sector. The entry to academe remains rooted in the early years; one starts a predominantly teaching-based career directly following the

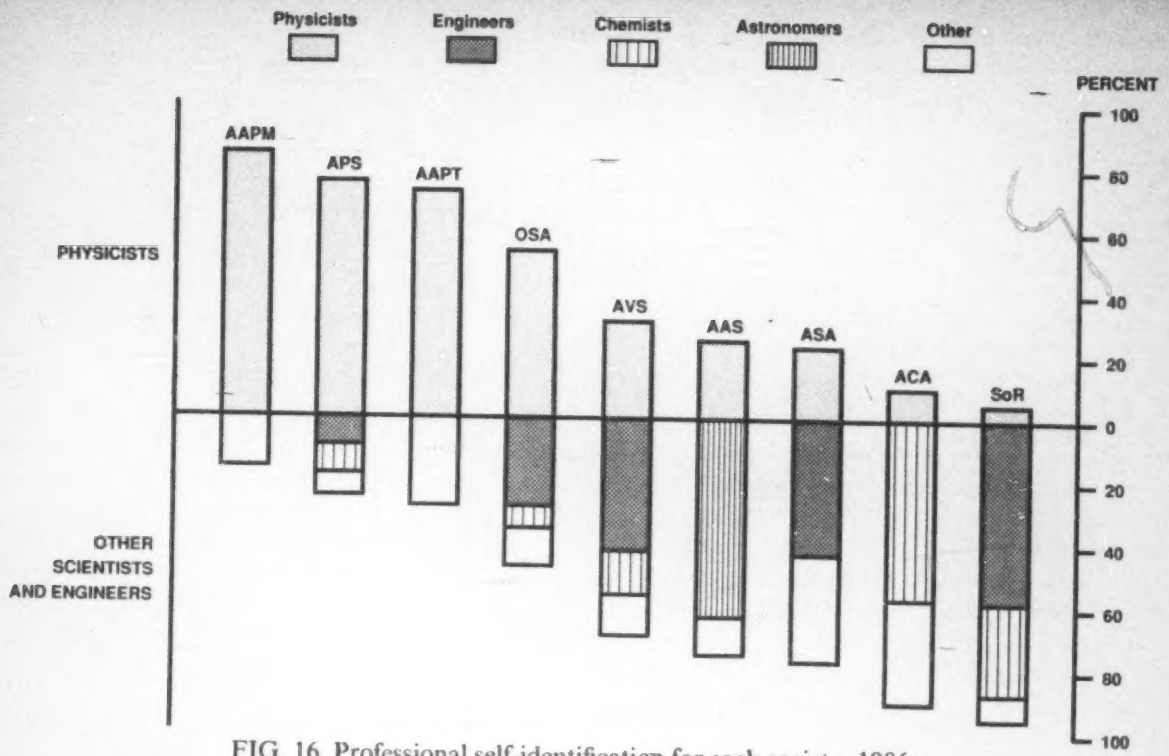

FIG. 16. Professional self-identification for each society, 1986.

PhD or pursues a career with greater research emphasis after the postdoctoral period. A number of PhDs leave academe during the postdoctoral or early faculty days, but only a very few either enter or leave it at later stages. Even the exchange between universities is minimal at the tenured staff level. The reasons for this lack of flexibility may be partly structural, but during the past decade the dearth of academic positions has accentuated the rigidity in the university sector.

As the decade of the 1990's progresses, one can expect a continuation of industrial demand and a significant increase in academic openings as faculty members retire. The question then turns to how these positions will be filled. The quest for faculty candidates from subfields often tapped by industry is already proving difficult. The search may prove even more problematic in the 1990's. Yet it is a crucial search for the scientific community. The university remains not only the training ground for the next generation but also the primary home of basic research.

Can the flexibility of the scientific labor force address the potential needs of the coming decade? Our analysis indicates that the early career years have traditionally been the period when change predominates. With special efforts and increased funding resources, we may be able to draw a somewhat higher proportion of these young PhDs into academe initially and to retain them once they start an academic career. The pool of candidates, however, is likely to remain limited. We may well have to look beyond the new PhD group if we are to satisfy the needs of both academe and industry.

Individuals who are further along in their careers present an alternative resource of highly skilled talent, albeit a resource which may prove more difficult to mine. As our analysis has indicated, many careers, particularly in academe, tend to stabilize in the mid-career years. While PhDs working in industry and government laboratories are somewhat more used to shifting work activities and places of employment as market demands change, at the current time few of these shifts have entailed moves into academe. Most of these experienced PhDs have had little direct involvement in basic research or teaching for many years. Economic differentials between academic and non-academic employment also act as barriers to easy mobility.

As the academic environment opens up and competition for scarce human resources increases, however, new mechanisms to ease transitions between employment sectors may emerge. Clearly new patterns of career choice and mobility will be called for if the scientific labor force is to be fully responsive to the new demands of the coming decade.

SOCIETY MEMBERSHIP COMPARISONS

As an umbrella organization, AIP brings together nine autonomous societies, each with its own agenda

TABLE XIV. International distribution of membership for each society, 1986.[a]

	AVS %	AAPM %	AAPT %	AAS %	APS %	ASA %	SoR %	OSA %	ACA %
United States	91	91	89	87	86	84	82	82	79
Europe	4	3	4	5	6	7	7	8	10
Canada	2	4	3	4	3	3	4	3	4
Asia	2	1	2	2	4	4	5	5	4
C/S America	1	-	1	1	1	1	1	1	1
Australia	-[b]	1	1	1	-	1	1	1	2

[a] Based on all members current on 12/31/85.
[b] Dashes indicate less than 1% of that society's membership.

and character.[6] This section and the one that immediately follows provide a glimpse of the distinctiveness of the societies, their unique concerns and composition. Inquiries for more specific, in-depth information on any one society are welcomed and can be obtained by contacting the Education and Employment Statistics Division.

Each society has a unique constituency. This is illustrated in Figure 16, which depicts the professional self-identification of the members of the nine societies. Each has a rich admixture of individuals with different backgrounds. It can be noted that physicists predominate in the American Association of Physicists in Medicine (AAPM), the American Association of Physics Teachers (AAPT), The American Physical Society (APS), and the Optical Society of America (OSA). By contrast, the Acoustical Society of America (ASA), the American Vacuum Society (AVS), and The Society of Rheology (SoR) are populated mostly by engineers, the American Astronomical Society (AAS) by astronomers and the American Crystallographic Association (ACA) by chemists. In addition, a significant number of psychologists and audiologists can be found in ASA, crystallographers in ACA and educators in AAPT.

Societies also vary according to geographic distribution. Table XIV presents the international location of members for each of the nine AIP Member Societies. Although all nine boast a worldwide membership, some societies are more heavily U.S.-based than others. AAPM and AVS, for example, draw over 90% of their members from within the United States. By contrast, ACA, OSA and SoR have a comparatively strong foreign component; roughly 20% of their membership resides abroad, mostly in Europe, Canada and Asia. National membership rolls for all societies are largest in heavily populated states such as California and several of the industrial states along the east coast (Table XV). One notable exception is AAPT, whose members are somewhat more evenly distributed throughout all fifty states than the other societies.

Despite this diversity, all the societies are united by common scientific and technological concerns. One indicator of this is multiple society membership, illustrated in Table XVI. Close to 9% of all members belong to two or more societies. The largest overlap exists between APS and AAPT; one out of every five AAPT members also belongs to APS. In fact, with the exception of ASA members, dual membership in APS and one of the other seven societies is common.

[6] While the American Geophysical Union (AGU) is now a Member Society of AIP, it was not at the time of this survey. The next profile in this series will highlight the characteristics of AGU members.

TABLE XV. U.S. membership concentration within major states for each society, 1986.

	AVS %	AAPM %	AAPT %	AAS %	APS %	ASA %	SoR %	OSA %	ACA %
California	24	12	14	19	17	14	9	22	11
New York	11	9	10	6	11	8	10	11	14
Massachusetts	7	-	6	8	7	7	6	8	5
New Jersey	5	-	-	-	-	-	10	5	5
Maryland	-	5	-	10	5	6	-	-	-
Illinois	-	6	-	-	5	-	5	-	5
Pennsylvania	5	6	5	-	-	-	6	-	6
Texas	-	6	-	-	-	6	-	-	5
Ohio	-	5	-	-	-	-	10	-	-

[a] Based on all members current on 12/31/85 and residing in the U.S.
[b] Dashes indicate less than 5.0% of that society's membership.

TABLE XVI. Society cross membership, 1986.[a]

	APS %	AAPT %	OSA %	AVS %	ASA %	AAS %	AAPM %	ACA %	SoR %
APS	**83**[b]	22	19	17	6	16	11	12	13
AAPT	6	**75**	4	1	2	3	3	1	-
OSA	5	3	**76**	3	2	4	1	1	1
AVS	3	1	2	**80**	-	-	-	1	-
ASA	1	1	1	-	**92**	-	-	-	-
AAS	2	1	2	-	-	**79**	-	-	-
AAPM	1	1	-	-	-	-	**86**	-	-
ACA	-	-	-	-	-	-	-	**86**	-
SoR	-	-	-	-	-	-	-	-	**86**
Total Membership	31 104	8963	8034	4925	4868	3936	2196	1440	1049

[a] Based on all members current on 12/31/85 and residing in the U.S. or Canada.
[b] Diagonal percentages (in bold) represent single society membership.
[c] Dashes represent less than 1% of the society's membership. Each column will not sum to 100% because of members who belong to more than two societies are counted more than once.

SOCIETY MEMBERSHIP PROFILES

American Association of Physicists in Medicine (AAPM)

AAPM was founded in 1958 to promote the application of physics to medicine and biology. Its membership is drawn heavily from both PhD and masters level physicists located at universities, hospitals, not-for-profit research centers, and in private group practice. Trained in medical, nuclear or solid-state physics, radiology, or biophysics, AAPM members are now primarily involved in either medical or radiation physics. PhDs employed in universities often hold a joint appointment at a university affiliated hospital and actively pursue applied research and administration as well as clinical work. At the masters level, many are involved in radiology, patient care, dosimetry and the like. Along with a relatively young membership, AAPM enjoys a high proportion of female members.

American Association of Physics Teachers (AAPT)

Common pedagogic and educational concerns unite the members of AAPT. Drawn from the full range of academic settings, nearly three out of every four AAPT members describe their primary work activity as teaching. On the whole, most AAPT members have had advanced graduate training. At the PhD level, AAPT members are found in universities and four-year colleges, where they divide their time between teaching, basic research, and administration. Among masters degree recipients, employment at junior colleges and secondary schools predominate. AAPT is the only society to have substantial representation of these latter two groups, many of whom identify themselves as educators. This reflects AAPT's continuing efforts to promote quality science education nationwide.

American Astronomical Society (AAS)

With a membership which topped 4,000 in 1986, AAS continues to attract professionals with an interest in astronomy and astronomy-related fields. Typically, AAS members identify themselves as astronomers, work in either astronomy or astrophysics, and either hold a PhD or are working towards completion of one. Approximately half of all AAS members are employed in a university. The remaining 50% are mostly distributed among government, the national labs and industry. AAS members are the youngest of all AIP society members and the representation of women among the membership is relatively substantial.

American Crystallographic Association (ACA)

ACA members identify themselves primarily as chemists. For many, their interests lie in crystallography, chemistry, materials science, and, to a lesser extent, biophysics and the biological sciences. Although university employment is most common, ACA members can also be found in substantial numbers in industry and government. ACA boasts a high percentage of PhDs, and the largest proportion of female members among all of the AIP Member Societies.

American Physical Society (APS)

Founded in 1899 and with a membership which is projected to top 40,000 in the next decade, APS is the largest Member Society. Although predominantly an organization of PhD physicists, APS attracts professionals from many scientific and technological disciplines, including chemistry, engineering, astronomy, and biology. All major employment sectors are represented here as well, with university employment providing a strong academic base. Industry, which has assumed increasing importance over the years,

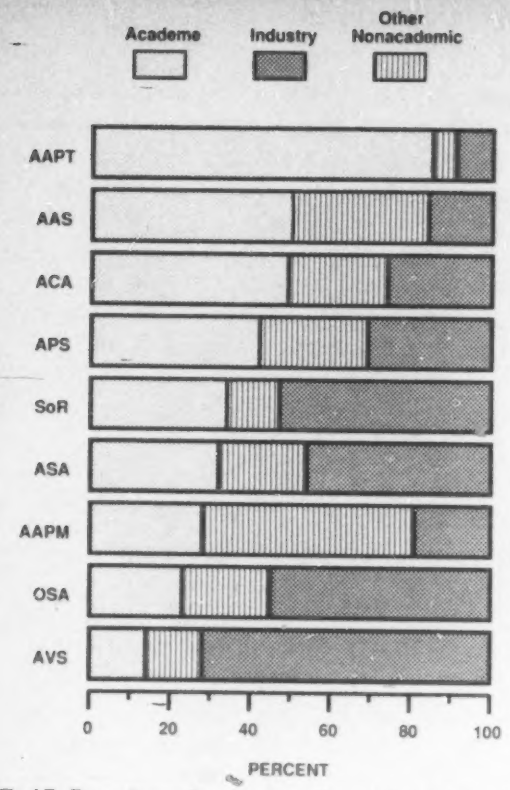

FIG. 17. Broad employer types for each society, 1986.

government and the national laboratories together employ over half of the membership. Research and teaching continue to be the primary work activity of most APS members, although this varies by employer.

Acoustical Society of America (ASA)

ASA members hail from a wide range of educational and employment backgrounds, including acoustics, audiology, electrical, electronic and mechanical engineering, psychology and even the biomedical sciences. Industrial employment is the norm here, with ASA members from all degree levels being attracted to industry by the opportunity to work in applied research, design, and engineering. Universities also draw a large number of ASA members, usually from the ranks of the PhDs, to either do basic research or teach. As one of the oldest societies, ASA has a broad agenda which encompasses and promotes this diversity.

American Vacuum Society (AVS)

Since the late 1970's membership in AVS has increased steadily, making it the most rapidly growing Member Society. AVS members identify themselves primarily as engineers, secondarily as physicists and chemists. As in the past, industry plays an important role here; seven out of every ten AVS members are employed in the private sector, where their work focuses on applied research and development. This is particularly true among bachelors who make up close to one-third of the membership, the highest proportion among the nine Member Societies. At the same time, half of all AVS members have earned a doctorate. In comparison to their lower degree counterparts, PhDs in AVS are more likely to be involved in basic research, to be employed by a university or national laboratory, and to work outside engineering in a physics or physics-related discipline.

Optical Society of America (OSA)

As the third largest Member Society, OSA represents scientists at all degree levels and employment settings. Typically, bachelors level OSA members work in industry, where they are primarily involved in design/engineering and development. Masters are also concentrated in industry, and to a lesser extent government, where they work in several capacities, including design/engineering, applied research, and development. PhDs tend to be employed at universities and in industry, where applied and basic research, as well as teaching, reign. Half of all OSA members identify themselves as physicists, another quarter as engineers. In addition to optics, OSA members work in a broad range of areas, including atomic and molecular physics, electric, electronic, and systems engineering, solid state physics and psychology. The common bond between OSA members at every degree level, employment sector, and subfield of work, is an interest in the scientific, technical and educational aspects of optics.

Society of Rheology (SoR)

SoR is the smallest of the AIP Member Societies. However, membership in SoR has grown steadily since its inception in 1929, and now numbers over 1,000. SoR members are most frequently employed as industrial engineers and chemists involved in applied research and development. In the universities, where about one-third of all SoR members are employed, PhD researchers predominate. In addition to rheology, society members interests include chemical engineering, high polymer physics, materials science, chemical physics and mechanics.

APPENDIX A: DROPPING SOCIETY MEMBERSHIP

Typically, individuals first join one of the AIP member societies as advanced graduate students. Most of them maintain their membership as they move on to employment; many maintain their affiliation even in retirement. For some, however, membership is a more transient phenomenon. What motivates people to discontinue membership? Although relatively few of these individuals who have severed their ties with the societies respond to our employment and salary inquiries, over the years we have amassed information on nearly 400 of them.

A small group of former members entered a society while studying in the U.S. on temporary visas. Upon completion of their degrees they returned home, discarding their societal affiliations. Most individuals who leave a society, however, do so later in their careers. For them, dropping membership reflects diverging career directions and interests. This is illustrated more clearly in the tables below.

Individuals most at risk for dropping society membership are those who work outside of physics and astronomy. One-quarter of all former society members are self-described engineers. Others are employed in related scientific disciplines such as mathematics and chemistry. Although many had originally been trained in physics, they are now working outside the field and have gone on to join organizations which more closely reflect their current interests. Non-scientists such as business administrators, lawyers and general educators account for over 10% of all dropped members and are especially prone to discontinuing their membership.

Former members can be further characterized by where they work and what they do. "Traditional" society members, that is, those engaged in university research and teaching, tend to remain members through-

TABLE A-1. Professional self-identification for dropped and current members, 1986.

	Dropped Members %	Current Members %
Physicist/Astronomer	42	63
Engineer	27	16
Other Scientist	18	16
Other	13	5
Total Number Known	373	6356
No Response	2	16

TABLE A-2. Major field of work for dropped and current members, 1986.

	Dropped Members %	Current Members %
Physics/Astronomy	45	67
Engineering	22	13
Other Sciences	21	15
Other Non-Science	12	5
Total Number Known	291	5379
No Response	43	451

TABLE A-3. Level of highest degree for dropped and current members, 1986.

	Dropped Members %	Current Members %
PhD	47	68
Masters	34	20
Bachelors[a]	19	12
Total Number Known	374	6346
No Response	1	26

[a] Includes technical and other degrees.

TABLE A-4. Type of employer for dropped and current members, 1986.

	Dropped Members %	Current Members %
Industry/Self-Employed	43	32
Other Nonacademic	19	23
University/College	25	39
Jr. College/Secondary School	13	6
Total Response Known	324	5742
No Response	10	88

TABLE A-5. Primary work activity for dropped and current members, 1986.

	Dropped Members %	Current Members %
Teaching/Basic Research	36	49
Applied Research/Development	27	27
Design/Engineering	12	6
Administration/Other	25	18
Total Number Known	325	5709
No Response	9	121

out their careers. For those involved in industrial design, engineering or administration, by contrast, membership is apt to be more short-term. Other high risk groups include junior college faculty and secondary school instructors.

Membership drives have successfully drawn individuals from a broad spectrum of traditional and non-traditional backgrounds. Many have maintained their membership over the years, while others, particularly from atypical backgrounds, sample the society activities and services for a year or two and then move on to other organizations that address their interests more directly.

APPENDIX B: GEOGRAPHIC DIVISIONS

NEW ENGLAND
- Connecticut
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont

MIDDLE ATLANTIC
- New Jersey
- New York
- Pennsylvania

SOUTH ATLANTIC
- Delaware
- District of Columbia
- Florida
- Georgia
- Maryland
- North Carolina
- South Carolina
- Virginia
- West Virginia
- Puerto Rico

EAST NORTH CENTRAL
- Illinois
- Indiana
- Michigan
- Ohio
- Wisconsin

EAST SOUTH CENTRAL
- Alabama
- Kentucky
- Mississippi
- Tennessee

WEST NORTH CENTRAL
- Iowa
- Kansas
- Minnesota
- Missouri
- Nebraska
- North Dakota
- South Dakota

WEST SOUTH CENTRAL
- Arkansas
- Louisiana
- Oklahoma
- Texas

MOUNTAIN
- Arizona
- Colorado
- Idaho
- Montana
- Nevada
- New Mexico
- Utah
- Wyoming

PACIFIC
- Alaska
- California
- Hawaii
- Oregon
- Washington

APPENDIX C: DETAILED STATISTICAL TABLES

Page

Demographic Characteristics, 1986

Table C-1. Professional self-identification, 1986. 25
Table C-2. Regional distribution of society members in the U.S., 1986 and total U.S. population. 25
Table C-3. Age profiles of society members, 1986. 25
Table C-4. Level of highest degree by years from highest degree, 1986. 25
Table C-5. Race and minority status by citizenship, 1986. 25

Employment Characteristics, 1986

Table C-6. Employment status, 1986. 25
Table C-7. Type of employer, 1986. 26
Table C-8. Principal work activity, 1986. 26
Table C-9. Principal work activity by level of highest degree, 1986. 26
Table C-10. Type of employer by highest degree, 1986. 26
Table C-11. Employer type by sex, 1986. 26
Table C-12. Work activity by degree level for members employed in industry, 1986. 26
Table C-13. Current employer type by year of PhD, 1986. 27
Table C-14. Type of employer by professional self-identification, 1986. 27
Table C-15. Work activity by type of employer, 1986. 27
Table C-16. Predominant fields and subfields of academic work by employer type, 1986. 28
Table C-17. Predominant fields and subfields of non-academic work by employer type, 1986. 28
Table C-18. Age profile by academic rank, 1986. 29
Table C-19. Age profile by tenure status, 1986. 29
Table C-20. Predominant fields and subfields of work by highest degree, 1986. 29
Table C-21. Detailed fields and subfields of work, 1986. 30
Table C-22. Corporations employing the largest number of society members, 1986. 30
Table C-23. Professional self-identification for Canadians, 1986. 30
Table C-24. Type of employer for Canadians, 1986. 30
Table C-25. Primary work activity for Canadians, 1986. 31

Salary Overview, 1986

Table C-26. PhD median salaries, reported and adjusted for inflation, 1979–86. 31
Table C-27. 1986 salaries by type of employer and years from PhD. 31
Table C-28. University and 4-year college salaries for PhDs by academic rank, 1986. 32
Table C-29. 1986 median salaries adjusted for cost of living in selected metropolitan areas. 32

Employer Mobility and Career Change

Table C-30. Level of employer mobility between 1981 and 1985 for different age groups. 32
Table C-31. Initial employment of recent PhDs, 1981. 32
Table C-32. Continuation in dissertation subfield through 1985, recent PhDs. 33
Table C-33. Employer mobility between 1981 and 1985 in the experienced labor force by type of employer. 33
Table C-34. Employer mobility and salary between 1981 and 1985 in the experienced labor force. 33
Table C-35. Mobility between 1981 and 1985 of experienced PhDs in government by initial work activity in 1981. 34
Table C-36. Retirement in the 1980's by age and employment sector. 34
Table C-37. Age profile of individuals aged 55 or older who moved from full- to part-time employment. 34
Table C-38. Age profile of individuals aged 60 or older who moved from one full-time job to another. 34

Society Membership Detail, 1986

	Page
Table C-39. Age structure for each society, 1986.	35
Table C-40. Professional self-identification for each society, 1986.	35
Table C-41. Type of employer for each society, 1986.	35
Table C-42. Level of highest degree for each society, 1986.	36
Table C-43. Primary work activity for each society, 1986.	36

TABLE C-1. Professional self-identification, 1986.

	%
Physicist	58
Engineer	16
Chemist	9
Astronomer	5
Other Scientist	7
Other	5
Total Number Known	6356
No Response	16

TABLE C-2. Regional distribution of society members in the U.S., 1986 and total U.S. population.[a]

Region	Society Members %	U.S. Population %
New England	10	5
Middle Atlantic	20	16
South Atlantic	15	17
East North Central	14	17
East South Central	3	6
West North Central	4	7
West South Central	6	11
Mountain	8	6
Pacific	20	15
Total Number Kno	57804[b]	241 Million

[a] Source: U.S. Bureau of the Census, Current Population Reports, Series P-25.

[b] Based on all society members as of 12/31/85.

TABLE C-3. Age profile of society members, 1986.

Age	%
< 30	10
30–34	14
35–39	13
40–44	15
45–49	14
50–54	10
55–59	8
60–64	8
65 +	8
Total Number Known	6204
No Response	167

TABLE C-4. Level of highest degree by years from highest degree, 1986.[a]

Years from highest degree	Level of Highest Degree: PhD %	Masters %	Bachelors %
0–4	13	12	12
5–9	15	15	14
10–14	16	15	13
15–19	18	14	9
20–24	14	14	8
25–29	9	9	11
30–34	7	7	7
35 +	8	14	26
Total Number Known	4259	965	433
No Response	21	9	4

[a] Advanced graduate students are not included in this table.

TABLE C-5. Race and minority status by citizenship, 1986.

Race and Minority Status	Citizenship: U.S. N.	Non-U.S. N.	Total	%
White	5113	447	5560	90.2
Oriental and Other Asian	208	271	479	7.8
Black, American Indian, and Hispanic	68	7	75	1.2
Other	36	15	51	0.8
Total Number Known	5425	740	6165	
No Response	79	19	98	

TABLE C-6. Employment status, 1986.

	%
Employed Full-Time	83
Employed Part-Time	8[a]
Not Employed, Not Seeking[b]	8
Not Employed, Seeking Employment	1
Total Number Known	6372

[a] 70% of those indicating part-time employment are advanced graduate students.

[b] Includes retired.

TABLE C-7. Type of employer, 1986.

	%
ACADEMIC	**46**
University	36
College	4
Junior College	2
Secondary School	4
NONACADEMIC	**54**
Industry/Self-Employed	32
Government	9
FFR&DC	9
Nonprofit	4
Other	-
Total Number Known	5742
No Response	88

TABLE C-8. Principal work activity, 1986.

	%
Teaching	22
Basic Research	27
Applied Research	20
Development	7
Design/Engineering	6
Administration	11
Consulting/Other	7
Total Number Known	5709
No Response	121

TABLE C-9. Principal work activity by level of highest degree, 1986.

	PhD %	Masters[a] %	Bachelors[a] %
Teaching	22	32	12
Basic Research	31	4	6
Applied Research	21	17	15
Development	6	12	13
Design/Engineering	4	12	24
Administration	11	11	15
Consulting/Other	5	12	15
Total Number Known	3985	854	374
No Response	50	14	7

[a] Advanced graduate students are not included.

TABLE C-10. Type of employer by highest degree, 1986.

	PhD %	Masters[a] %	Bachelors[a] %
ACADEMIC	**47**	**37**	**16**
University	40	7	4
College	5	3	-
Jr. College	1	7	2
Secondary School	1	20	10
NONACADEMIC	**53**	**63**	**84**
Industry/Self-Employed	28	40	65
Government	10	10	10
FFR&DC	11	4	5
Nonprofit	4	8	3
Other	-	1	1
Total Number Known	4012	861	375
No Response	23	8	6

[a] Advanced graduate students are not included.

TABLE C-11. Employer type by sex, 1986.

	Male %	Female %
ACADEMIC	**45**	**53**
University	36	37
Other Academic	9	16
NONACADEMIC	**55**	**47**
Industry and Self-Employed	33	24
Government	9	10
FFR&DC	9	7
Nonprofit and Other	4	6
Total Number Known	5264	469
No Response	78	10

TABLE C-12. Work activity by degree level for members employed in industry, 1986.

Work Activity	PhD %	Masters[a] %	Bachelors[a] %
Basic Research	14	2	4
Applied Research	38	25	14
Development	16	21	17
Design/Engineering	9	24	30
Administration	12	15	17
Consulting/Other	11	13	18
Total Number Known	1140	343	242
No Response	5	4	1

[a] Advanced graduate students are not included.

TABLE C-13. Current employer type by year of PhD, 1986.[a]

	1984–1986 %	1981–1983 %	1978–1980 %	1975–1977 %	1972–1974 %	1969–1971 %	1966–1968 %	Before 1966 %
ACADEMIC	**32**	**36**	**40**	**40**	**38**	**43**	**50**	**56**
University	27	30	35	33	31	34	42	51
Other Academic	5	6	5	7	7	9	8	5
NONACADEMIC	**68**	**64**	**60**	**60**	**62**	**57**	**50**	**44**
Industry/Self-Employed	46	38	39	33	31	30	23	22
Other Nonacademic	22	26	21	27	31	27	27	22
Total Number Known	191	331	394	364	428	452	432	1243
No Response	2	2	1	0	0	0	0	15

[a] Postdocs are not included.

TABLE C-14. Type of employer by professional self-identification, 1986.

	Physicists %	Astronomers %	Engineers %	Chemists %	Computer Scientists %	Other Scientists %	Other %	Total %
ACADEMIC	**49**	**61**	**23**	**50**	**23**	**56**	**52**	**46**
University	38	54	21	44	14	50	12	36
Other Academic	11	7	2	6	9	6	40	10
NONACADEMIC	**51**	**39**	**77**	**50**	**77**	**44**	**48**	**54**
Industry/Self-Employed	25	9	63	30	54	21	37	32
Government	10	13	8	8	4	10	4	9
FFR&DC	11	13	4	9	8	5	1	9
Nonprofit	5	4	2	3	11	8	4	4
Other	-	-	-	-	-	-	2	-
Total Number Known	3329	271	919	497	85	360	267	5728
No Response	51	4	11	9	0	7	3	85

TABLE C-15. Work activity by type of employer, 1986.

	University %	Other Academic %	Industry %	Government %	FFR&DC %	Other %
Teaching	36	91	-	2	-	2
Basic Research	46	1	10	31	38	22
Applied Research	8	-	31	28	35	20
Development	1	-	17	8	6	5
Design/Engineering	1	-	16	4	6	2
Administration	6	7	14	21	12	15
Consulting/Other	2	1	12	6	3	34
Total Number Known	2028	563	1808	527	514	252
No Response	24	3	10	5	4	4

TABLE C-16. Predominant fields and subfields of academic work by employer type, 1986.

	University		Other Academic	
	%		%	
PHYSICS AND ASTRONOMY	75		79	
Predominant Subfields of Work		Solid State Physics Elementary Particles Physics Ed. College Nuclear Physics		Physics Ed. College Astronomy Solid State Physics
ENGINEERING	7		3	
Predominant Subfields of Work		Mechanical Electronic Electrical		Electronic
OTHER SCIENCE	15		13	
Predominant Fields of Work		Chemistry Materials Science Computer Science		Computer Science Materials Science Chemistry
OTHER AREAS	3		5	
Total Number Known	1630		487	
No Response	68		74	

TABLE C-17. Predominant fields and subfields of non-academic work by employer type, 1986.

	Industry		Government		National Laboratory	
	%		%		%	
PHYSICS AND ASTRONOMY	50		66		76	
Predominant Subfields of Work		Optics Solid State Physics Acoustics		Solid State Physics Acoustics Astrophysics Optics		Plasma Physics Solid State Physics Nuclear Elementary Particles
ENGINEERING	26		12		9	
Predominant Subfields of Work		Electronic Electrical		Electronic Systems		Nuclear Electronic
OTHER SCIENCE	16		17		11	
Predominant Fields of Work		Materials Science Computer Science Business Management		Science Administration Earth Science		Materials Science Chemistry
OTHER AREAS	8		5		4	
Total Number Known	1652		494		496	
No Response	135		28		10	

TABLE C-18. Age profile by academic rank, 1986.[a]

Age	Prof. %	Associate Prof. %	Assistant Prof. %	Research Assoc. %	Other[b] %
< 30	-	-	4	14	6
30–34	-	4	40	38	19
35–39	2	23	32	25	14
40–44	12	28	14	12	19
45–49	26	22	5	7	17
50–54	21	11	2	3	10
55–59	18	6	2	1	6
60–64	14	5	1	-	7
65 +	7	1	-	-	2
Total Number Known	902	326	235	189	106
No Response	12	12	8	4	3

[a] Includes university and college full-time employed only. Graduate students are not included.
[b] Includes administrators, lecturers and instructors.

TABLE C-19. Age profile by tenure status, 1986.[a]

Age	Tenured %	Tenure-line %	Other %
< 30	-	3	7
30–34	1	31	25
35–39	5	35	21
40–44	15	16	21
45–49	25	8	13
50–54	20	4	6
55–59	16	2	3
60–64	12	1	2
65 +	6	-	2
Total Number Known	1136	262	271
No response	21	9	8

[a] Includes university and college full-time employed only. Graduate students are not included.

TABLE C-20. Predominant fields and subfields of work by highest degree, 1986.[a]

	PhD %		Masters %		Bachelors %	
PHYSICS AND ASTRONOMY	69		63		53	
Predominant Subfields of Work		Solid State Physics Astronomy/Astrophysics Physics Ed. College Optics Plasma Physics		Physics Ed. (SS)[b] Optics Physics Ed. College Medical Physics		Optics Vacuum Science Physics Ed. (SS)[b] Acoustics
ENGINEERING	11		20		27	
Predominant Subfields of Work		Electronic Electrical Systems		Electronic Systems Electrical		Electronic Systems Mechanical
OTHER SCIENCE	16		12		12	
Predominant Fields of Work		Chemistry Materials Science Computer Science		Computer Science Materials Science Chemistry		Materials Science Chemistry
OTHER AREAS	4		5		8	
Total Number Known	3829		774		339	
No Response	206		95		42	

[a] Advanced graduate students are not included.
[b] SS: Secondary School.

TABLE C-21. Detailed fields and subfields of work, 1986.

	N.	%
Physics and Astronomy Subfields	**3608**	**67**
Solid State Physics	439	
Optics	332	
Physics Education, College	295	
Elementary Particles and Fields	211	
Plasma Physics	198	
Nuclear Physics	184	
Astrophysics	178	
Chemical Physics	171	
Medical Physics	159	
Atomic and Molecular Physics	157	
Astronomy	145	
Physics Education, Pre-College	144	
Acoustics	142	
General Physics	128	
Mathematical Physics	58	
Biophysics	57	
Electronics	57	
Fluid Science	51	
Vacuum Science	49	
Radiological Physics	48	
Surface Science	48	
Geophysics	47	
High Polymer Physics	45	
Electromagnetism	43	
Crystallography	39	
Low Temperature Physics	38	
Thermal Physics	26	
Mechanics	17	
Rheology	14	
Other Physics	88	
Engineering subfields	**713**	**13**
Electronic	155	
Electrical	93	
Systems	91	
Mechanical	77	
General Engineering	67	
Aeronautical and Astronomical	50	
Nuclear	48	
Chemical	39	
Metallurgy	12	
Environmental	7	
Other Engineering	74	
Other Science Fields	**797**	**15**
Chemistry	178	
Materials Science	152	
Computer Science	120	
Earth and Environmental Science	49	
Science Administration	48	
Audiology and Speech Science	44	
Psychology	44	
Biological Science	39	
Mathematics and Statistics	30	
General Science, Education	21	
Other Science	72	
Other Areas	**252**	**5**
Educational Administration	49	
Business Management	65	
Other Administration	67	
Other Nonscience	71	
Total Number Known	5370	
No Response	446	

TABLE C-22. Corporations employing the largest number of society members, 1986.

AT&T Bell Laboratories	Eastman Kodak
IBM	Exxon
General Electric	Westinghouse
Hughes Aircraft	Boeing
TRW	Honeywell
Rockwell International	Texas Instruments
Lockheed	

TABLE C-23. Professional self-identification of Canadians, 1986.

	%
Physicist	63
Engineer	9
Astronomer	9
Chemist	9
Other Scientist	7
Other	3
Total Number Known	223
No Response	1

TABLE C-24. Type of employer for Canadians, 1986.

	%
ACADEMIC	**64**
University	57
College	4
Other Academic	3
NONACADEMIC	**36**
Industry/Self-Employed	14
Government	18
Other	4
Total Number Known	210
No Response	1

TABLE C-25. Primary work activity for Canadians, 1986.

	%
Teaching	30
Basic Research	35
Applied Research	15
DDE[a]	7
Administration	7
Other	6
Total Number Known	208
No Response	4

[a] DDE: Development, Design and Engineering.

TABLE C-26. PhD median salaries, reported and adjusted for inflation, 1979–86.[a]

	Reported Salary	Salary in 1979 $'s
1979	28,000	28,000
1980	32,200	28,100
1981	36,000	28,400
1982	38,300	28,300
1983	41,000	29,200
1984	43,200	29,400
1985	46,000	30,200
1986	49,500	31,700

[a] Salaries were adjusted using CPI-U for the inflation rate.

TABLE C-27. 1986 salaries by type of employer and years from PhD.

	Years from Degree	Median Salary	Mean Salary	Standard Deviation	Median Age	Total Number Known
University (9–10 month salary base)	0–4	28.0	29.6	5.7	32	46
	5–9	30.5	31.7	6.1	36	94
	10–14	35.9	37.1	9.9	41	88
	15–19	39.5	41.2	9.0	45	152
	20–24	43.7	46.1	10.8	49	170
	25 +	50.0	52.0	13.5	59	259
University (11–12 month salary base)	0–4	33.0	34.3	9.0	32	37
	5–9	37.8	39.1	10.2	36	81
	10–14	43.2	46.2	14.0	41	78
	15–19	51.0	56.3	20.4	45	81
	20–24	58.0	57.7	13.9	50	67
	25 +	62.0	64.1	13.6	58	83
Industry	0–4	44.3	44.6	8.2	32	156
	5–9	51.0	53.5	11.2	36	228
	10–14	57.0	58.7	14.4	41	200
	15–19	61.8	64.7	16.8	45	184
	20–24	67.0	71.8	24.7	50	107
	25 +	70.0	74.8	25.3	59	153
Government	0–4	37.0	38.3	7.8	32	30
	5–9	41.0	43.4	8.6	39	46
	10–14	49.5	49.0	6.9	42	73
	15–19	54.8	54.1	8.4	46	62
	20–24	57.8	57.5	8.3	50	51
	25 +	67.7	62.6	9.6	60	69
National Labs	0–4	42.0	40.4	7.5	32	40
	5–9	48.9	46.9	7.9	36	68
	10–14	52.6	53.0	9.5	40	85
	15–19	56.0	58.0	10.1	45	94
	20–24	60.0	61.8	10.3	50	56
	25 +	61.2	66.4	16.9	58	67

Table C-28. 1986 university salaries by selected academic rank and salary base, PhDs.

	QUARTILE SALARIES						
	25th	Median (in thousands of dollars)	75th	Mean Salary	Standard Deviation	Median Age	Total Number Known
Professor							
9–10 Month Salary	39.8	46.4	55.8	48.6	12.1	52	541
11–12 Month Salary	51.1	60.0	69.5	61.4	14.7	52	175
Associate Professor							
9–10 Month Salary	30.3	34.5	38.5	34.9	6.2	43	148
11–12 Month Salary	42.5	48.0	56.0	51.7	17.7	42	74
Assistant Professor							
9–10 Month Salary	26.0	28.1	33.0	29.7	5.0	34	107
11–12 Month Salary	32.0	37.0	40.8	37.2	9.1	35	61
Research Associate (11–12 Month Salary)							
Postdoctorates	21.0	23.0	25.0	23.3	3.4	32	71
Other Research Staff	30.0	36.6	44.0	38.1	10.1	39	55

TABLE C-29. 1986 median salaries adjusted for cost of living in selected metropolitan areas.[a]

	Cost of Living Index	Median Salary (in thousands of dollars)	Adjusted Salary	Median Age	Academic %	Non-Academic %	Total Number Known
Albuquerque	104.4	55.6	53.3	43	13	87	52
Austin	110.4	46.5	42.1	44	76	24	29
Baltimore	105.9	46.0	43.4	43	49	51	35
Cleveland	101.6	48.0	47.2	41	32	68	22
Columbus	103.9	39.6	38.1	46	75	25	36
Houston	104.7	52.6	50.2	43	43	57	46
Los Angeles	112.3	54.0	48.1	44	30	70	130
New York	142.0	53.0	37.3	47	47	53	113
Philadelphia	117.9	39.0	33.1	43	60	40	40
San Diego	122.7	48.3	39.4	45	36	64	50
San Jose	111.2	55.0	49.5	41	28	72	42
Seattle	108.8	47.0	43.2	40	58	42	20

[a] Cost of Living Index from the American Chamber of Commerce Researchers Association, national average = 100.0.

TABLE C-30. Level of employer mobility between 1981 and 1985 for different age groups.

Age	Changed Employer %	Total Number Known
< 35	45	179
35–39	33	436
40–44	19	608
45–49	14	565
50–54	12	399
55–59	9	320
60–64	13	243
65 +	18	103

TABLE C-31. Initial employment of recent PhDs, 1981.[a]

	%
Industry	31
Posdoctoral Position	27
Academe	24
Government & National Lab	14
Other	4
Total Number Known	351

[a] Based on individuals who received their doctorates between 1978 and 1981.

TABLE C-32. Continuation in dissertation subfield through 1985, recent PhDs.[a]

1985 Work Subfield	1981 Employer: Postdoctoral %	Academe %	Industry %	Government and National Laboratories %	Overall[b] %
Same as dissertation	68	55	35	44	50
Different than dissertation	32	45	65	56	50
Total Number Known	93	80	101	45	332

[a] Based on individuals who received their doctorates between 1978 and 1981.
[b] Includes individuals starting employment in other employment settings.

TABLE C-33. Employer mobility between 1981 and 1985 in the experienced labor force by type of employer.[a]

1981 Employer	Changed Employers	Total Sample Number
University	10%	1048
Other Academic	16%	170
Industry	22%	577
Government	17%	279
National Labs	11%	303
Non-Profit	19%	86
Overall[b]	15%	2491

[a] Based on individuals who received their doctorates prior to 1978.
[b] Includes those employed in other employment settings.

TABLE C-34. Employer mobility and salary between 1981 and 1985 in the experienced labor force.[a]

1981 Employer/1985 Sector	1981 Salary (in thousands of dollars)	1985 Salary (in thousands of dollars)	Age in 1985	Total Number Known
University				
Same Employer in '85	33.1	44.7	50	877
Different Academic Employer in '85	31.5	48.0	44	43
Left Academe by '85	27.5	50.0	44	58
Industry				
Same Employer in '85	45.0	60.0	46	400
Different Industrial Employer in '85	39.5	55.0	43	82
Left Industry by '85	38.9	50.0	47	29
National Laboratories				
Same Employer in '85	39.0	53.2	46	245
Different National Lab in '85	*	*	*	*
Left National Labs by '85	36.8	54.3	45	26

[a] Based on individuals who received their doctorates prior to 1978.
*Number too small to calculate reliable statistics.

TABLE C-35. Mobility between 1981 and 1985 of experienced PhDs in government by their initial work activity in 1981.[a]

1981 Work Activity	Subsequent Employment Mobility, 1985		
	Remained With Agency %	Changed Agency %	Left Goverment %
Research	67	43	39
Development, Design & Engineering	7	28	14
Administration	26	29	47
Total Number Known	231	21	25

[a] Based on individuals who received their doctorates prior to 1978.

TABLE C-36. Retirement in the 1980's by age and employment sector.[a]

Age	Full-time Employer				
	University %	Other Academic %	Industry %	Other Non-Academic %	Overall %
Younger than 64	20	53	41	47	40
64–66	28	27	32	30	30
Older than 66	52	20	27	23	30
Total Number Known	50	51	78	59	238
Median Age	67	63	65	64	65

[a] Based on sample members who moved from full-time employment to retirement during the period 1979–1986.

TABLE C-37. Age profile of individuals aged 55 or older who moved from full- to part-time employment.

Age	Full-time Employer			
	University %	Industry %	Other Non-Academic %	Overall[a] %
55–63	40	56	60	54
64–66	34	21	6	20
Older than 66	26	23	34	26
Total Number Known	33	35	35	112
Median Age	65	63	62	63

[a] Includes individuals employed in other employment settings.

TABLE C-38. Age profile of individuals aged 60 and older who moved from one full-time job to another.

Age	Initial Full-time Employer			
	University %	Industry %	Other Non-Academic %	Overall[a] %
60–63	32	78	73	67
64–66	45	15	17	23
Older than 66	23	7	10	10
Median Age	65	61	62	62
Total Number Known	15	27	32	81

[a] Includes those who were employed in other employment settings.

TABLE C-39. Age structure for each society, 1986.

	Quartile Age		
	25th	Median	75th
AAS	35	41	49
AAPM	37	42	48
AVS	33	42	53
ACA	37	44	55
OSA	35	44	54
SoR	34	44	57
APS	35	45	55
ASA	36	45	58
AAPT	42	48	58

TABLE C-40. Professional self-identification for each society, 1986.

	AAPM %	AAPT %	AAS %	ACA %	APS %	ASA %	AVS %	OSA %	SoR %
Physicist	84	72	25	10	75	23	31	53	5
Astronomer	-[a]	2	63	-	1	-	-	1	-
Engineer	4	5	3	5	9	43	42	28	58
Chemist	2	3	-	57	9	-	14	7	29
Biologist	-	-	-	9	-	3	-	1	1
Math & Compt. Sci.	2	3	3	4	2	2	-	1	1
Other Scientist	5	2	3	13	2	22	4	7	6
Other	3	13	3	2	2	7	9	2	-
Total Number Known[b]	406	953	448	266	3662	495	406	772	192
No Response	-	6	2	-	4	2	2	1	-

[a] Dashes indicate that less than 1.0% of a society's members identify themselves with the noted group.
[b] Note that respondent totals here reflect the stratified over-sampling of the three smallest societies: AAPM, ACA, & SoR.

TABLE C-41. Type of employer for each society, 1986.[a]

	AAPM %	AAPT %	AAS %	ACA %	APS %	ASA %	AVS %	OSA %	SoR %
ACADEMIC	**28**	**85**	**50**	**49**	**42**	**32**	**14**	**23**	**34**
University	26	32	44	45	37	30	13	21	33
College	2	16	5	3	4	2	1	2	1
Junior College	-	9	1	1	1	-	-	-	-
Secondary School	-	28	-	-	-	-	-	-	-
NONACADEMIC	**72**	**15**	**50**	**51**	**58**	**68**	**86**	**77**	**66**
Industry/Self-Employed	19	9	16	26	31	46	72	55	53
Government	6	3	16	11	11	15	3	11	8
FFR&DC	1	1	14	8	13	1	9	7	3
Non-profit and other	46	2	4	6	3	6	2	4	2
Total Number Known[b]	380	844	390	235	2985	401	374	653	168
No Response	3	5	5	0	18	3	4	6	1

[a] Students are not included.
[b] Note that respondent totals here reflect the stratified over-sampling of the three smallest societies: AAPM, ACA & SoR.

TABLE C-42. Level of highest degree for each society, 1986.

	AAPM %	AAPT %	AAS %	ACA %	APS %	ASA %	AVS %	OSA %	SoR %
PhD	53	57	91	88	90	60	52	65	80
Masters	42	36	7	9	7	27	18	21	15
Bachelors	5	7	2	3	3	13	30	14	5
Total Number Known[a]	382	926	413	250	3213	450	358	706	181
No Response	-	-	1	1	3	-	6	6	-

[a] Note that respondent totals here reflect the stratified over-sampling of the three smallest societies: AAPM, ACA, & SoR.

TABLE C-43. Primary work activity for each society, 1986.[a]

	AAPM %	AAPT %	AAS %	ACA %	APS %	ASA %	AVS %	OSA %	SoR %
Teaching	5	73	17	20	19	17	6	10	18
Basic Research	3	6	47	46	32	12	14	16	17
Applied Research	22	4	12	13	21	27	25	31	36
DDE[b]	13	5	7	9	11	19	31	28	15
Administration	13	9	11	7	12	12	16	11	11
Other	44	3	6	5	5	13	8	4	3
Total Number Known[c]	373	840	391	234	2960	399	372	653	168
No Response	10	9	4	1	43	5	6	6	1

[a] Students are not included.
[b] DDE: Design, Development and Engineering.
[c] Note that respondent totals here reflect the stratified over-sampling of the three smallest societies: AAPM, ACA, & SoR.

APPENDIX D: METHODOLOGY

Sampling Frame

In order to provide employment information on the AIP Member Societies, the Education and Employment Statistics Division of AIP inaugurated a membership survey in 1979. At that time, a small segment of the membership was contacted by mail and asked to describe their work-related activities. Two years later the survey was expanded to randomly sample one-sixth of the U.S. and Canadian membership. (The three smallest Member Societies, the American Association of Physicists in Medicine, American Crystallographic Association and The Society of Rheology, were oversampled by a factor of two to achieve a large enough sample size to permit detailed analysis.) In 1987 the survey was further expanded to include the newest AIP Member Society, the American Geophysical Union (AGU). The information presented in this report was collected before the entrance of AGU; future salary and profile reports will include analysis of all ten AIP Member Societies.

Response Rates

This report is based on the eighth annual membership survey, conducted in the spring of 1986. As in previous years, the survey followed-up on sample members and expanded to include new members, that is, individuals who joined their first society any time during 1985. Questionnaires were sent in April, and a second mailing went out in June to those who had not yet responded to the first wave. Table D-1 summarizes the response rates for the 1986 survey. Of the 10,801 questionnaires sent to members, roughly 100 were lost to follow up, due either to an illness or death, an unreported address change, or a request for exclusion from the sample. Another 6,752 completed questionnaires were returned, representing a response rate of 63%. As in the past, individuals who dropped society membership responded less consistently than current members.

TABLE D-1. Response rates for 1986 Sample Survey.

	Society Members	Dropped Members	Overall
Sample Size	10801	1474	12275
Presumed Contacted*	10697	1221	11918
Number Respondents	6752	394	7146
Response Rate (%)	63.1	32.3	60.0

*Individuals requesting to be removed from the sample, those who moved abroad and the deceased are not included.

Sources of Error and Bias

Several potential sources of error and bias must be noted here. First, this is a sample survey, not a population-based inquiry. The ability to generalize to the membership as a whole based on a description of a sample of members is therefore subject to sampling error. Estimation of sampling error is covered in the next section. Second, the survey took the form of a self-administered questionnaire; some errors due to misinterpretation of questionnaire items may have occurred. Appendix F contains both survey forms used in 1986. Finally, although the response rate was relatively high, in any survey there remains the question, do responders differ in any significant way from non-responders? Earlier inquiries into this question have answered equivocally, no, yet the possible effect remains. Please consult the 1981 profile report for a detailed exploration of response bias and the membership survey.

APPENDIX E: DEFINITIONS AND TECHNICAL NOTES

Employment Status

All employment tables presented in this report include both full-time and part-time employed U.S. and Canadian members unless otherwise noted. Salary data, by contrast, are limited to individuals residing in the U.S. who are full-time employed. Where feasible, academic salaries reported on a 9–10 month and 11–12 month salary base are presented separately. When overall figures are given, there is no weighting for salary base.

Field and Subfield

Appendix F contains the field and subfield list which was sent with the questionnaire. It was used by respondents to indicate the area in which they received their highest degree and their primary and secondary subfields of work. In addition, individuals provided their major professional self-identification: physicist, astronomer, engineer, chemist, computer scientist, mathematician, biologist, other scientist, and other.

Cost of Living Index

The cost of living index used in this report was developed by the American Chamber of Commerce Researchers' Association (ACCRA). Its purpose is to provide "a useful and reasonably accurate measurement of inter-city cost of living differences." The index measures "relative price levels for consumer goods and services in participating cities, as compared with the national average for all participating cities (metropolitan and nonmetropolitan)." Differences of more than three whole numbers in index can be considered to represent actual inter-city differences in the costs of consumer goods and services; however the percentage difference in such cases should be considered a reasonable indication, rather than a precise measure, of the extent of the differences.

Median

The median, a measure which is used in this report, is that point in a distribution above and below which 50% of the values fall. Since it is less influenced by extreme values than the arithmetic mean it is the preferred descriptive measure of central tendency in typically skewed salary and age distributions. In Appendix C, both median and mean salaries are presented; observed differences reflect the skewness in the distributions.

Quantiles and Interquantile Ranges

Ninety percent of the values in a distribution fall below the ninth decile, seventy-five percent below the third quartile, twenty-five percent below the first quartile and ten percent below the first decile. The interdecile and interquartile ranges, which indicate differences between deciles and between quartiles, are measures of variation within distributions.

Quantile Calculations

The P-STAT statistical package was used to compute the medians and other quantiles presented in this report. Percentiles were not interpolated when the requested quantiles fell a certain fraction into a group of equal values or when fractional weights were used.

Sampling Error

The percentages and other measures presented in this report are based upon a small random sample. Thus, they are subject to sampling error. The variability introduced by the sampling procedure depends both upon the size of the sub-group being examined and the variation of values in the population. When standard errors were calculated, taking into account the minor stratification used in the sampling, slightly lower estimates than observed under simple random sampling conditions resulted.

Longitudinal Analysis of Career Mobility and Change

The discussion of career mobility and change, the focus of this year's profile report, was based on analyses of three particular groups.

The study of early career development was limited to those sample members who had received their doctorate some time between 1978 and 1981, had responded to the 1981 and 1985 surveys, and were employed either full or part-time both in 1981 and 1985. Career movement was then defined as the difference between the 1981 and the 1985 responses. This kind of longitudinal approach, in which individuals are followed at two or more points in time, provides the clearest picture of stability and change.

Mid-career analyses were performed on sample members who received their PhD before 1978, responded to both the 1981 and 1985 surveys, and were employed in non-postdoctoral, full-time positions in both 1981 and 1985. Major shifts in employment, e.g., changes in academic rank or employer, were examined at these two endpoints, 1981 and 1985, but not during the intervening years.

In order to garner the largest possible number of people moving toward the end of their careers, retirement was studied by looking at sample members who had responded at least twice, any time between the inception of the survey in 1979 and 1986. All movement into retirement, whether from full-time employment or part-time employment was included. However, not all late-career change involves retirement; many professionals seek either part-time or new full-time employment late in their careers. Therefore, people over the age of 54 who moved from full-time employment to part-time employment, and those over the age of 59 who moved from full-time employment to a different full-time employer, also were singled out for investigation.

All longitudinal analyses includes both current members of an AIP Member Society, and those who dropped society membership sometime during the period covered. Although the pattern of career change among lower degree holders is of interest, the relatively small proportion of masters and bachelors degree holders among the membership does not permit a detailed analysis.

APPENDIX F: QUESTIONNAIRE INSTRUMENTS AND SUBFIELD LIST

AIP MANPOWER STATISTICS DIVISION

1986 MEMBERSHIP SAMPLE SURVEY

PLEASE NOTE ADDRESS CHANGES IN COMMENT BOX ON FIELD/SUBFIELD LIST

PLEASE

Print numbers with pencil clearly in boxes as follows:

0 1 2 3 4 5 6 7 8 9

Use the digit '1' in place of check marks.

IMPORTANT: PROVIDE INFORMATION DESCRIBING YOUR STATUS IN MARCH 1986

BACKGROUND INFORMATION

(1) MAJOR PROFESSIONAL SELF-IDENTIFICATION (SELECT ONE)

PHYSICIST | ASTRONOMER | ENGINEER | CHEMIST | COMPUTER SCIENTIST | MATHEMATICIAN | BIOLOGIST | OTHER SCIENTIST * | OTHER *

(2) LEVEL OF HIGHEST DEGREE — DOCTORATE | MASTERS | BACHELORS | OTHER *

(3) DATE OF DEGREE — MONTH | YEAR

(4) SUBFIELD OF DEGREE — (SEE ATTACHED LIST) | THEORETICAL | EXPERIMENTAL | NEITHER

(5) IF STUDENT — INDICATE: GRADUATE | OTHER

(6) DATE OF BIRTH — MONTH | DAY | YEAR

(7) SEX — MALE | FEMALE

(8) CITIZENSHIP — UNITED STATES | CANADIAN | NON-US PERMANENT VISA | NON-US TEMPORARY VISA

(9) RACE/ETHNIC — WHITE | BLACK | ORIENTAL | OTHER ASIAN | NATIVE AMERICAN INDIAN | MEXICAN AMERICAN | PUERTO RICAN | OTHER

EMPLOYMENT STATUS, MARCH 1986

(10) WERE YOU: EMPLOYED — FULL TIME | PART TIME; NOT EMPLOYED — SEEKING | NOT SEEKING; RETIRED

(11) IF POSTDOC: INDICATE

(12) FIELD OR SUBFIELD OF WORK (SEE ATTACHED LIST) — PRIMARY | SECONDARY — THEORETICAL | EXPERIMENTAL | NEITHER

(13) TYPE OF WORK ACTIVITY (INDICATE PRIMARY WITH "1" AND SECONDARY WITH "2") — ADMINISTRATION | DESIGN ENGINEERING | DEVELOPMENT | APPLIED RESEARCH | BASIC RESEARCH | TEACHING | CONSULTING | OTHER *

(14) ANNUAL SALARY AS OF MARCH 1986 (NOT BENEFITS OR PENSIONS) (US CDN $) — IF ACADEMIC INDICATE SALARY BASE: 9-10 MOS | 11-12 MOS

(15) PLEASE PRINT FULL NAME OF EMPLOYER

CITY | STATE COUNTRY

U.S. EMPLOYER ZIP CODE ONLY

PLEASE DO NOT MARK THESE BOXES

(16) TYPE OF EMPLOYER (INDICATE PRIMARY WITH "1" AND, IF APPLICABLE, SECONDARY WITH "2")

UNIVERSITY | COLLEGE | JUNIOR COLLEGE | SECONDARY SCHOOL | INDUSTRY | GOVERNMENT | FEDERALLY FUNDED R & D CENTERS (e.g. Argonne) | HOSPITAL | NON-PROFIT | SELF-EMPLOYED | OTHER *

IF ACADEMIC, answer a and b

a) PRIMARY ACADEMIC RANK — PROFESSOR | ASSOC PROF | ASST PROF | RESEARCH ASSOCIATE | ADMINISTRATOR | SECONDARY SCHOOL TEACHER | OTHER *

b) TENURE STATUS — TENURED | TENURE LINE | OTHER *

* IF YOUR RESPONSE IS "OTHER," PLEASE SPECIFY IN COMMENT BOX ON FIELD/SUBFIELD LIST.

FORM A7

AIP MANPOWER STATISTICS DIVISION

MEMBERSHIP SAMPLE SURVEY
1986 UPDATE

PLEASE NOTE ADDRESS CHANGES IN COMMENT BOX ON FIELD/SUBFIELD LIST

PLEASE

Print numbers with pencil clearly in boxes as follows:

0 1 2 3 4 5 6 7 8 9

Use the digit '1' in place of check marks.

PLEASE INDICATE WITH "1" ANY STATUSES IN A & B THAT APPLIED IN **MARCH 1986**

A) EMPLOYED: FULL TIME ☐ PART TIME ☐ | NOT EMPLOYED: SEEKING ☐ NOT SEEKING ☐ | RETIRED ☐

B) POSTDOC ☐ STUDENT ☐

BASIC ANNUAL SALARY AS OF **MARCH 1986:** (NOT BENEFITS OR PENSIONS) ☐☐☐,☐☐☐ (US CON $)

IF ACADEMIC INDICATE SALARY BASE: 9-10 MOS. ☐ 11-12 MOS. ☐

HAVE YOU MADE ANY CHANGES IN AREAS 1-7 BELOW SINCE MARCH 1985?

IF **NO** SIMPLY RETURN FORM IN ENCLOSED ENVELOPE

IF **YES** INDICATE *NEW* STATUS ONLY IN THE RELEVANT AREAS BELOW

IMPORTANT: REPORT CHANGES MADE BETWEEN **MARCH 1985** AND **MARCH 1986** ONLY

1 TYPE OF WORK ACTIVITY? (INDICATE PRIMARY WITH "1" AND SECONDARY WITH "2")

ADMINISTRATION ☐ | DESIGN ENGINEERING ☐ | DEVELOPMENT ☐ | APPLIED RESEARCH ☐ | BASIC RESEARCH ☐ | TEACHING ☐ | CONSULTING ☐ | OTHER* ☐

2 EMPLOYER?

PLEASE PRINT FULL NAME OF *NEW* EMPLOYER

U.S. EMPLOYER ZIP CODE ONLY ☐☐☐☐☐

PLEASE DO NOT MARK THESE BOXES ☐☐☐☐☐

TYPE OF EMPLOYER (INDICATE PRIMARY WITH "1" AND SECONDARY WITH "2")

UNIVERSITY ☐ | COLLEGE ☐ | JUNIOR COLLEGE ☐ | SECONDARY SCHOOL ☐ | INDUSTRY ☐ | GOVERNMENT ☐ | FEDERALLY FUNDED R & D CENTERS (eg. Argonne) ☐ | HOSPITAL ☐ | NON-PROFIT ☐ | SELF-EMPLOYED ☐ | OTHER ☐

3 FIELD OR SUBFIELD OF WORK? (SEE ATTACHED LIST)

PRIMARY 1) ☐☐☐ | THEORETICAL ☐ | EXPERIMENTAL ☐ | NEITHER ☐

SECONDARY 2) ☐☐☐ | THEORETICAL ☐ | EXPERIMENTAL ☐ | NEITHER ☐

4 ACADEMIC RANK?

a) PRIMARY ACADEMIC RANK: PROFESSOR ☐ | ASSOC PROF ☐ | ASST PROF ☐ | RESEARCH ASSOCIATE ☐ | ADMINISTRATOR ☐ | SECONDARY SCHOOL TEACHER ☐ | OTHER* ☐

b) TENURE STATUS: TENURED ☐ | TENURE LINE ☐ | OTHER* ☐

5 NEW HIGHEST DEGREE?

A) LEVEL OF DEGREE: DOCTORATE ☐ | MASTERS ☐ | BACHELORS ☐ | OTHER* ☐

B) DATE OF DEGREE: MONTH ☐☐ YEAR ☐☐

C) PRIMARY SUBFIELD OF DEGREE (SEE ATTACHED LIST) ☐☐☐ | THEORETICAL ☐ | EXPERIMENTAL ☐ | NEITHER ☐

6 MAJOR PROFESSIONAL SELF-IDENTIFICATION?

PHYSICIST ☐ | ASTRONOMER ☐ | ENGINEER ☐ | CHEMIST ☐ | COMPUTER SCIENTIST ☐ | MATHEMATICIAN ☐ | BIOLOGIST ☐ | OTHER SCIENTIST* ☐ | OTHER* ☐

7 CITIZENSHIP?

UNITED STATES ☐ | CANADIAN ☐ | NON-US PERMANENT VISA ☐ | NON-US TEMPORARY VISA ☐

* IF YOUR RESPONSE IS "OTHER," PLEASE SPECIFY IN COMMENT BOX ON FIELD/SUBFIELD LIST

FORM B7

FIELD/SUBFIELD LIST

PHYSICS & ASTRONOMY

001 ASTRONOMY
040 ASTROPHYSICS
070 ACOUSTICS
100 ATOMIC AND MOLECULAR PHYSICS
130 BIOPHYSICS
160 CHEMICAL PHYSICS
190 CRYSTALLOGRAPHY
220 ELECTROMAGNETISM
250 ELECTRONICS
280 ELEMENTARY PARTICLES & FIELDS
310 FLUID DYNAMICS
350 GEOPHYSICS
380 HIGH POLYMER PHYSICS
410 LOW TEMPERATURE PHYSICS
440 MATHEMATICAL PHYSICS
470 MECHANICS
500 MEDICAL PHYSICS
530 NUCLEAR PHYSICS
560 OPTICS
590 PLASMA PHYSICS
600 RADIOLOGICAL PHYSICS
620 RHEOLOGY
650 THERMAL PHYSICS
680 SOLID STATE PHYSICS
720 SURFACE SCIENCE
740 VACUUM SCIENCE
760 PHYSICS, GENERAL
790 PHYSICS EDUCATION, PRE-COLLEGE
800 PHYSICS EDUCATION, COLLEGE
820 PHYSICS, OTHER (Specify below.)

ENGINEERING

835 AERONAUTICAL & ASTRONAUTICAL
840 CHEMICAL
845 ELECTRICAL
850 ELECTRONIC
855 ENVIRONMENTAL
860 MECHANICAL
862 METALLURGY
865 NUCLEAR
870 SYSTEMS
890 ENGINEERING, GENERAL
891 ENGINEERING, OTHER (Specify below.)

OTHER SCIENCE

893 AUDIOLOGY AND SPEECH SCIENCE
895 BIOLOGICAL SCIENCE
900 CHEMISTRY
905 COMPUTER SCIENCE
910 EARTH & ENVIRONMENTAL SCIENCE
912 GENERAL SCIENCE, EDUCATION
915 MATERIALS SCIENCE
920 MATHEMATICS & STATISTICS
925 PSYCHOLOGY
945 SCIENCE ADMINISTRATION
950 SCIENCE, OTHER (Specify below.)

OTHER AREAS

952 BUSINESS MANAGEMENT
955 EDUCATIONAL ADMINISTRATION
975 OTHER ADMINISTRATION
999 NON-SCIENCE, OTHER (Specify below.)

BIBLIOGRAPHY

Howard R. Bowen and Jack H. Schuster, *American Professor: A National Resource Imperiled* (Oxford University Press, New York, 1986).

David G. Brown, *The Mobile Professors* (American Council on Education, Washington, DC, 1967).

Dolores L. Burke, *A New Academic Marketplace* (Greenwood Press, New York, 1988).

Lee Grodzins, "The Supply and Demand for PhD Physicists" in *The Transition in Physics Doctoral Employment 1960–1990* (American Physical Society, New York, 1975).

Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, *An Assessment of Research–Doctorate Programs in the United States* (National Academy Press, Washington, DC, 1982).

National Research Council, *Departing the Ivy Halls* (National Academy of Science, Washington, DC, 1983).

National Research Council, Physics Survey Committee, *Physics Through the 1990's: Overview Volume* (National Academy of Sciences, Washington, DC, 1986).

National Research Council, *Postdoctoral Appointments and Disappointments* (National Academy Press, Washington, DC, 1981).

Carl V. Patton, *Academia in Transition* (Abt Books, Cambridge, MA, 1979).

Beverly Fearn Porter, "Transition: A Follow-up Study of 1973 Postdoctorals" in *The Transition in Physics Doctoral Employment 1960–1990* (American Physical Society, New York, 1975).